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## ENGINEERING NEWS.

THE ST. MARY'S CANAL, as shown in the annual report of Supt. E. S. WHEELER, is in traffic one of the greatest canals in the world. About 8,500 vessels passed through this canal in the fiscal year, carrying 6,932,203 tons of freight. This freight included 1,854,000 tons of coal, 3,414,000 tons of iron ore, 13,084,000 bus. wheat, 30,000 tons copper, 3,500 tons silver ore, 2,152,000 barrels of flour, 59,000 tons manufactured iron, 33,700 tons of building stone, 276,180,000 ft. B. M. lumber and 351,000 tons of miscellaneous freight. Since the opening of this channel around the St. Mary's Rapids about 45,000,000 tons have passed through the locks, with freight charges of about $300,000,000 less than would have been charged for railroad transport.

THE MASSACHUSETTS DRAINAGE COMMISSIONERS nominated by Gov. AMES, as previously noted, have been rejected by the executive council. Messrs. JNO. QUINCY ADAMS, HOSEA KINGMAN, and ASA FRENCH, forming the commission named, are all prominent citizens and good lawyers; but it was for the latter very proper reason that their confirmation was rejected. While Gov. AMES thought that even one engineer in this commission was likely to block progress by pushing schemes of his own, the council, along with other sensible men, thought that this objection could be easily met by appointing a proper engineer and that his technical knowledge would be more valuable on the commission than as a hired expert.

THE OFFICE OF CONSULTING ENGINEER on the New Croton Aqueduct was abolished by vote of the Commission on July 24, with Commissioner of Public Works GILROY alone dissenting. Mr. BENJ. S. CHURCH, the late consulting engineer, now holds a similar position with the lately organized International Manufacturing Association, a corporation designed to encourage the inventors of mechanical devices and to act as a medium through which such inventors may advantageously reach the public.

THE PROVIDENCE RAILWAY TERMINAL PLANS has been supplemented by "plan $x$" sent in by the railroad companies. It differs from the plan shown in our issue of April 17, 1889, in throwing the proposed passenger station entirely back of the center of the dotted circle, showing the limits of the old pond, and in also much increasing the station building. The freight yards are much enlarged in size and extend to the banks of the Woonasquatucket river on the west side. There is park space in the front and rear of the new station, and Francis St. is continued in a straight line under it, instead of over the tracks by a bridge. The main purpose in this plan is more room in station and yards. It is practically a modification of the experts' plan and would seem better adapted to the purpose intended.

THE BASIC STEEL PROCESS of JACOB REESE, its inventor, has been assigned in its patents to the Bessemer Steel Company, says an announcement of the inventor in the bulletin of the American Iron and Steel Association. Mr. REESE thinks the Bessemer process has seen its ultimate development in this country and that future increase in steel production will be largely, if not entirely, due to the further development of the basic process, for the reason that a better and purer metal can thus be made. The latter process is already in great demand for tin plate, thin sheets for stamping into trays and domestic utensils, for wire-drawing, drop-forging, wire nails, boiler plate, rivets, etc.

THE AMERICAN STEEL BARGE CO., of Duluth, Minn. launched on July 17 the first of its cigar-shaped steel barges, one of a fleet by which the company proposes to revolutionize freight transport on the lakes. This barge is 260 ft. long over all, 36.1 ft. beam, and 18.66 ft. molded depth. It has a capacity of 3,000 tons and will carry 100,000 bus. of grain. These barges are to be towed by powerful tugs, and the chief advantage claimed is the saving of time in handling the freight. The boat is all steel, and was built in four months at the works of the company in Duluth.

WORK ON THE NICARAGUA CANAL is said to now employ about 700 men, and the work of preparation for operation on a large scale is reported as well advanced. The natives of all degrees are very anxious to have the Americans commence spending their money in earnest.

THE ILLINOIS STEEL COMPANY is reported to have determined to establish a shipyard for the construction of steel lake steamers, probably at South Chicago, though the location is not yet definitely settled upon. Mr. W. I. BABCOCK, Superintendent of the Union Dry Docks at Buffalo, has accepted a position as the head of the mechanical department of this new enterprise. The Illinois Steel Company is formed by the consolidation of the North Chicago, the Union, and the Joliet companies, and at the Duluth meeting of stockholders, on June 10, the sum of $1,300, 000 was set aside from the surplus for the purpose here outlined.

THE NEW YORK AND NEW JERSEY BOUNDARY LINE through Staten Island Sound and Kill Von Kull is being surveyed and monumented by Messrs. Vermeule & Bien, civil and mining engineers, of New York, for the New York and New Jersey Boundary Commission. No definite line has ever before been fixed, and the last commission investigating the matter ceased its labors in 1833. This report of 56 years ago gives only the "middle" of the Hudson river, Bay of New York, the Staten Island waters, and Raritan Bay to the main sea as the boundary between the two States. The present commission, after much labor, has agreed upon the site of this "middle" line as it existed in 1833 as far north as Kill von Kull. This line has been surveyed with minute accuracy, and will be marked by granite range monuments on the shores, so that it may be readily retraced when required. The property involved has become very valuable and as a consequence the work of the commission and its engineers has been a delicate task. This journal has already published the names of the commissioners.

CHESAPEAKE & OHIO STOCK to the amount of 100,000 shares was transferred this week from Mr. C. P. HUNTINGTON to Drexel, Morgan & Co., who purchase, it is supposed, for the VANDERBILTS. In explaining editorially the "Bee Line" and "Big Four" consolidation in our issue of Feb. 16, 1889, we predicted that at an early date the whole Chesapeake & Ohio system from Chicago to Newport News would come under VANDERBILT control. It now seems likely that this will soon be realized, so that within a few months the Vanderbilt system will comprise the most southern as well as the most northern of the United States trunk lines.

THE DAVIS ISLAND DAM, in the Ohio river, below Pittsburg, Pa., is now being repaired, and some changes are also being made. It is reported that the upper dam was almost destroyed by high water during the recent floods. As soon as this is repaired a new chute will be made for the passage of logs, about 760 ft. long, the old pier in the center of the dam will be removed, and the old pier on the Davis Island side extended.

THE GENESEE WATER STORAGE PROJECT, under its resolution passed by the Senate of New York last winter, is being investigated by Mr. JOHN BOGART, State Engineer. The purpose of this water storage would be to afford a plentiful supply of water in case of need for the Erie Canal, and a supply more convenient than the present storage at Cuba dam, 50 miles further away from the canal.

THE LIST OF SUBWAY EXPLOSIONS on Broadway in this city, was supplemented by two more on the evening of July 19 at 19th and 20th Streets. Leakage from gas mains was again the cause, and while no one was injured, it was not the fault of the explosion, as paving blocks and manhole covers were said to have been thrown 15 ft. into the air. The crater formed was 4 ft. deep and 20 ft. in diameter.

THE GRAND CAÑON SURVEY down the Colorado river is apparently only temporarily checked by the death of President BROWN. A dispatch from Salt Lake City, of July 23, says that Chief Engineer R. B. STANTON will return and complete the survey for the railroad as soon as proper boats can be secured. Mr. STANTON reports that his party has examined 400 miles of the river from Grand Junction, Col., to the Marble cañon. He says that so far a railroad line is not only practicable, but it can be more easily and cheaply built than was expected before the survey.

PIG-IRON PRODUCTION, according to the statistics of the American Iron and Steel Association, was greater during the first 6 months of 1889 than in any preceding 6 months in the whole history of the iron trade. The total production of pig iron of all grades in the 6 months ending July 1 was 4,107,899 tons of 2,000 lbs., an increase of 198,121 tons over the production during the last half of 1888. The increased production was in the ordinary grades used for foundry purposes. Bessemer pig production showed a falling off. In the Southern States, Virginia, West Virginia, Alabama, and Tennessee show an increase, especially great in Alabama. Of the Northern States, New York, New Jersey, Ohio, and Pennsylvania show considerable increase. The stock of unsold pig iron on hand on June 30 was 502,934 tons, an increase of 202,790 tons over the stock on hand Jan. 1. From this it would seem that consumption has remained about stationary and that the increased production cannot be kept up. On June 30 there were 288 furnaces in blast and 293 out of blast.

CONCERNING THE WATER SUPPLY OF SPRINGFIELD, Mass., which it seems needs purification of some kind, a well-known expert writes as follows: "The water question has had much ventilation, condemnation, and damnation, caused by want of aeration and too much vegetation, which is without justification, hence much nauseation and taxation. Now give the water a thorough purification by combidation of aeration, filtration, clarification, precepitation, coagulation, oscillation, oxygenation, deodorization, and the water will be pure enough for all creation. To accomplish this we require negotiation, analyzation, elucidation, organization, association, emulation, animation, and above all things an appropriation. This will remedy the deterioration, put an end to the anathematization, expostulation, and imprecation, prevent the propagation of vegetation, and if done without procrastination will result in a general jollification,"—which combination of allocation and elucidation with a little imagination is worthy of approbation and final acceptation.

COMPRESSED AIR is to be used for the water-works tunnel at Cleveland, O. Considerable difficulty has been met with in the construction of the new tunnel under Lake Erie, due to striking a vein or bed of quicksand which runs diagonally across the line of the tunnel. Several efforts were made by the contractors, J. S. Casement & Co., to pass the bad ground by détours, but they invariably resulted in striking the same material, which drove the men out and filled up the heading so that some 400 ft. of tunnel were lost in the different attempts. Sooysmith & Co., contracting engineers, of New York City, have been retained as consulting engineers and to superintend the work of passing the difficult ground. They will use the pneumatic process, and will line the excavation with iron so far as is necessary to insure the stability of the brickwork.

BRIDGE ACCIDENTS are reported as follows: On July 13, the pontoon bridge at Nebraska City, Neb., was carried away by the flood.—On July 14, the piers of the Brady's iron bridge on the Pittsburg & Lake Erie Ry. were undermined by the flood, rendering the structure unsafe.—On July 16, a canal bridge at Thomson's Mills, near Saratoga Springs, N. Y., gave way under a team. The driver was killed.—On July 19, the West Shore Railway bridge at Indian Castle, N. Y., was washed out by a flood caused by a heavy rain storm in the Mohawk valley. —A highway bridge at Loxa, Ill., gave way recently under a traction engine. One man was killed.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment July 19 of a mixed train on the Meriden, Waterbury & Connecticut River Railway. The accident occurred at a bridge 30 ft. high, over the New York, New Haven & Hartford Railway, about a mile north of Meriden, Conn. The engine and four freight cars fell off the bridge and were wrecked, but the passenger cars stopped before going over. There were 3 persons seriously injured.——Two switch accidents are reported: On the Savannah, Florida & Western Railway, July 18, a sleepy or confused switchman opened a switch in front of an express train, running it into a freight train on the side track. One man was killed and 3 were injured. On the Montana Central an improperly fastened switch was jarred open by a passing freight train and derailed 4 of the cars.——A freight train was ditched on July 18 near Colorado, Tex. A section gang had a rail taken out to put in a new one, and the flag was put out such a short distance, and around a curve, that the engineer of the train found it impossible to stop in time, and ran into the gap.

THE BREAKAGE OF AN AXLE OF A LOCOMOTIVE occurred July 20, at Dayton, O., under peculiarly favorable circumstances, according to press dispatches The account given is as follows: "An axle of a locomotive drawing an Erie passenger train broke just as the train stopped at the depot here to-night. The first known of anything being wrong was when the wheel fell at the side of the track. The train being behind time had just made a fast run from Springfield, and had the axle broken on the, run a frightful accident must have resulted."

A SERIOUS DRAWBRIDGE ACCIDENT occurred on the night of July 20 at the St. Augustine creek drawbridge of the Tybee Railway near Savannah, Ga. An excursion steamer mistook the signal lights to indicate that the draw was open, and ran into the bridge. Two of the passengers were killed and about 30 injured, some seriously. The captain of the boat stated that a red light was displayed at each end of the draw, indicating that it was open, and throwing the blame on the bridge tender, who, however, is said to have signaled the boat of the danger. The bridge was not much injured.

EXTENSIVE AND DISASTROUS storms and floods are reported from Ohio and West Virginia. In the Little Kanawha valley several houses were washed away and some persons drowned. At Cincinnati, O., a break in the canal bank at York St. caused much damage; and at Lancaster, O., the Sarp dam on the Hocking canal gave way July 20. Several bridges were carried away and much damage done along the course of the canal. A heavy storm in the Mohawk Valley, July 19, raised the water in the creeks and caused the wreck of 3 or 4 bridges. Washouts have occurred on the Cincinnati, Washington & Baltimore, Hocking Valley, and Scioto Valley Railways; also on the Tybee Railway in Georgia. Landslides have occurred on the New York Central, West Shore, & Northern Pacific road.

AN AMERICAN WORKINGMEN'S EXPEDITION has been organized by six newspapers in Detroit and Cincinnati, with the purpose of sending 50 representative American workmen to the industrial centers of Europe and particularly to the Paris exposition. They sailed on the *City of Rome* on July 24. The men sent are especially selected for their knowledge of some particular trade, and they are accompanied by a staff of skilled correspondents, artists, and photographers.

THE GEOLOGICAL MAP OF NEW JERSEY, Sheet No. 20, and the last of the excellent series of maps published under the direction of Mr. GEORGE H. COOK, State Geologist, has been issued.

AN ARTESIAN WELL in North City, a suburb of St. Augustine, Fla., is reported as yielding a flow of 11,500,000 galls. in 24 hours through an 8-in. pipe. If the measurement is accurately made, of which we must have some doubt, this well exceeds the reported flow of the Ponce de Leon well, and gives the greatest yield of any known artesian well.

A TORONTO, CANADA, VIADUCT, along the water front, is being discussed in that city. The idea is to connect the high ground east and west of the city by a high viaduct carrying the C. P. R. tracks, which now occupy much of the present water front. The estimated cost is $400,000 per mile, and the length would be between four and five miles. The City Engineer is engaged in making plans.

THE BRIDGING OF BEHRING STRAITS is declared to be feasible by explorer JOHN MUIR, the discoverer of the Muir glacier. He says the strait is only 60 miles across, with three islands strung through it, and the water is shallow, in some places not exceeding 20 ft. in depth. The trouble would come in from floating ice.

"IMPROVEMENTS IN STEAM ENGINES SINCE 1878" is the title of a paper to be presented at the International Congress of Applied Mechanics, to be held in Paris in September, by Mr. ROBERT GRIMSHAW, Consulting Engineer, of 21 Park Row, New York City. Mr. GRIMSHAW has been appointed by the French Ministry of Commerce and Industry a member of the Committee on Patronage of this Congress, and he desires detailed information from engine builders, inventors, and others, as soon as possible, as to novelties or improvements brought out during the past ten years.

AN IMPORTANT WATER POWER IN MEXICO is being developed about four miles from Guadalajara, by Mr. C. H. M. BLAKE, an American engineer. It is at a cotton mill owned by SeñorFRANCISCO MARTINEZ NEGRETO, which has been running some years, using as power a 24-ft. English overshot wheel giving a useful effect of about 22 H. P. Mr. BLAKE has contracted to increase this power, and has sunk a shaft 88.6 ft. deep and 13 ft. in diameter through solid rock, and for a tail-race he has cut a tunnel communicating with an adjacent *arroyo*. The new wheel is a 20-in. Leffel turbine. Undeveloped water power abounds in this section of Mexico.

A BETTER SURVEY OF THE LAKES was demanded at the late Buffalo meeting of the Lake Carriers' Association. The members claim that many of the existing maps and charts are now inaccurate, especially in the depths of water noted.

CARRYING THE MAILS AT 300 MILES PER HOUR, a scheme which is now occupying the attention of several inventors, is not a new project. As long ago as 1826 a Mr. VALLANCE, in England, proposed to transport "goods and passengers" at the rate of 100 miles per hour in cars propelled through a tube by the exhaustion of the air. And in 1845, Mr. WM. H. JAMES published in the *Mechanics' Magazine* plans for a mail carrier which was to travel at the rate of 300 miles per hour. Mr. JAMES proposed to use both air-exhausting and air-compressing machines, operating upon vulcanized rubber spheres which carried the load. These spheres were to be ordinarily 15 ins. in diameter, but smaller 2¼-in. balls, working in metal tubing, were to be used for government dispatches, etc. In some of its features this scheme was very like the Judson patent, now being exhibited and lately noticed in this journal.

THE THOMSON-HOUSTON EUROPEAN ELECTRIC WELDING COMPANY, was organized at Boston this week, and these directors chosen: OLIVER AMES, S. ENDICOTT PEABODY, B. F. SPINNEY, J. M. SMITH, W. A. BOLAND, CHARLES T. LEWIS, S. A. VAN HOFFMAN, S. D. BABCOCK, HENRY D. HYDE. They chose OLIVER AMES president and W. A. BOLAND treasurer. The stock of the company is $1,500,000.

THE WATER-JET SYSTEM OF STEAMER PROPULSION seems to be growing in public confidence by actual performance. Dr. JACKSON'S method has several times been referred to in this journal, in which with a 150 H. P. pump he proposes to force a ¾-in. jet of water from the stern-post under a pressure of 2,500 lbs. to the sq. inch. Dr. E. FLEISCHER, now of London, has built a vessel, the *Hydromoter*, which has made several successful trips at a high rate of speed between Kiel and Copenhagen. In this vessel the water is ejected under the keel amidships. The advantage claimed for these new motors is increased speed, increased safety, and no jar or vibration from the machinery.

THE NEW RIVER COMPANY'S (LONDON) water stock is gilt-edged. A single share which originally cost $500 was said to have been sold in London on July 17 at auction for $614,600. Though the dispatch does not say so, this share was without doubt one of the original shares of the water company as started by HUGH MIDDLETON in 1613; and the difference between the nominal and real value only represents the growth of the enterprise in the interval. Last year shares paid a dividend of $13,050.

A CAST STEEL-CAR WHEEL PATENT interference was decided this week by the Commissioner of Patents. The case was between the Fowler Cast Steel Car Wheel Company, of Chicago, vs. the Pittsburg Steel Casting Company. The Pittsburg company was charged with infringement of the Fowler patent and of joining with Mr. C. B. BEACH, of Cleveland, O., in filing an application for a patent professedly based upon a prior and abandoned application for a patent for cast car wheels. The commissioner decided in favor of FOWLER on the ground that the BEACH application had been abandoned until FOWLER had conceived the same thing, put it into practical shape and manufactured it on an extensive scale.

THE DAILY COAL CONSUMPTION on the *City of Paris* is 310 tons; on the *Augusta-Victoria* it is 230 tons; on the *Wisconsin* 65 tons; *Weser* 40 tons; and *Abyssinnia*, 55 tons. The *City of Paris* carries 2 300 tons of coal for a trip and the *Augusta-Victoria*, 2,100 tons. These are figures obtained directly from the vessels named by the *Marine Journal*.

THE POLLUTION OF THE PASSAIC RIVER was the subject of a suit by the Newark Aqueduct Board against the city of Passaic. The latter city proposes to discharge a daily average of 60,000 galls. of sewage into the river from which Newark and Jersey City take their water supply. Chancellor MCGILL now denies the application of Newark for a permanent injunction, on the ground that Newark has no rights in the case, and because "the sewage has not done the injury to the water that was expected, as the tidal flow purifies the stream." This is about as absurd a decision, if correctly reported, as could be made, and if applied to the other rivers of New Jersey is likely to do much mischief.

AN AMERICAN TRANSATLANTIC STEAMSHIP LINE is again proposed, with Mr. AUSTIN CORBIN at its head and a capital of $10,000,000. A similar scheme, with the same leading name, failed two years ago, but it seems there is now better prospect of success, According to current rumor, the proposed outfit would include eight steamships of American build, of 13,000 tons each, costing $1,250,000 each. It is also said that 3,200 acres of land have been purchased at Montauk Point, at the east end of Long Island for a steamship terminal that would save considerable time in transit across the ocean.

## The Transit Problem in the City of New York.

By a Civil Engineer.

The object of a comprehensive transit scheme is to supplement those existing railway lines which may be regarded as permanent, in such manner that the carrying system, as a whole, shall make transit easy, rapid, and cheap, between every two points within the city limits.

It may first be premised that when the distance to be traveled does not exceed a mile and a half, most persons, if given a choice, prefer to use a surface road rather than a railway accessible only by means of stairways or elevators, at stations a number of blocks apart. No rapid transit system can command so large a part of this short travel as to render the longitudinal surface roads unnecessary.

Two four-track rapid transit railways can be made to meet all demands of carrying capacity for some years to come. These railways should extend from the Battery to a point near the upper city line, and form a continuous belt, 31 miles in length. No branch or loop should be connected into any of these four tracks. As a further condition of attaining the greatest possible capacity and speed, no track should be curved with a less radius than 500 ft.

The maximum train should consist of eight forty-seated coaches, with side doors, no platforms, and a system of connections such that the interior of the train will present somewhat the appearance of one long car. Every train should run over the whole route between termini; and the train houses be located at a point beyond the upper terminus.

A cross-section of the road at stations is shown in the following diagrams.

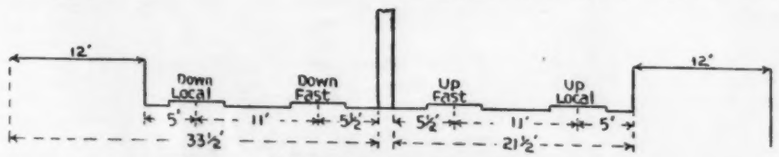


**Fig. 1. Stations where Fast Trains do not Stop.**

In running from terminus to terminus, a fast train makes nine stops, and a local train forty-one. The intertrack platforms (stopping points for the fast trains) are located at the four lowermost stations, at Forty-second St., Eighty-sixth St., One Hundred and Twenty-sixth St., and at three points (including the upper terminus) above One Hundred and Twenty-sixth St.

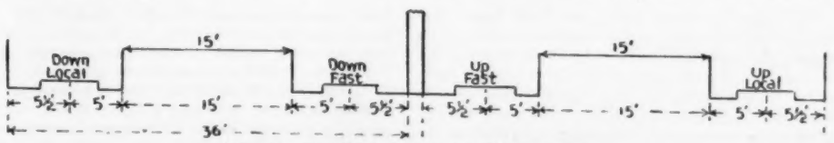


**Fig. 2. Stations where All Trains Stop.**

There are 36 platforms 15 × 350 ft., and 128 platforms 12 × 350 ft. The average distance apart of the 82 stations is 1,996 ft.

Motive power should be provided adequate to move the maximum loaded trains up the steepest gradient at a speed of 50 miles an hour. The running time between termini, including stops, may then be 30 minutes for each fast train, and 60 minutes for each local train.

Not fewer than 20 trains an hour should pass every station on each track from early in the morning until late in the evening; but it may probably be permissible to begin at 11 or 11.30 P. M. to withdraw the fast trains, and to reduce the number of trains passing each station on the local tracks to not fewer than six an hour.

The two proposed railways, although having a sufficient carrying capacity, cannot in themselves provide for travel diagonally across the city, or be of any use to those numerous persons in areas of the city remote from the railways who want to ride long distances, but cannot or will not walk far, or pay double fares. But both the foregoing requirements can be met by constructing and operating a cross-town surface road in each street where a station of the main railway is located. The tracks should be laid with rails which will not obstruct ordinary street traffic. Electricity could, perhaps, be used as the motive power. The average speed of the cross-town cars, including stops, should be restricted to six miles an hour.

The fare on the main railways should be 5 cts.

On the cross-town roads, the fare may be 3 or 4 cts.

The payment of 6 cts. on a cross-town car should entitle the passenger to the cross-town ride and a main railway ticket.

Any holder of an intact main railway ticket should be entitled to a cross-town ride, upon paying the car conductor a cent, and presenting the ticket to be punched. Punching a ticket would invalidate it for any further use on a cross-town car, but leave it good for a ride on the main railway.

A number of cross-town roads are already in operation; and, in the ordinary course of events, additional roads will be built from year to year. The question, therefore, is, not whether the cross-town roads shall have existence, but whether the public shall reap the advantage of having them operated as feeders to rapid transit railways, at the least fare which will pay expenses. In carrying out the suggested plan, it would be necessary to acquire control of most of the existing cross-town roads, to reconstruct and re-equip them, and to build others. The city officers should have power to authorize an increase of cross-town fares, if any year's business shows a considerable loss; and to require that the fares be decreased if any year's business shows a considerable profit. Travel would, no doubt, be assisted in finding its natural channels, were the owners of the longitudinal surface railways party with the rapid transit company to the construction and operation of the cross-town system. Six cents would then pay for a cross-town ride, and a ticket receivable on either of the rapid transit roads, or on any longitudinal surface railway.

Assuming that money will buy any railroad in New York—or elsewhere—all difficulties in the way of providing the cross-town system are convertible into terms of expense.

A cross-town equation might be expressed as follows: Let $i$ = interest on cost of the cross-town roads, at whatever rate the money can be borrowed; $\alpha$ = their maintenance and operating expenses; $x$ = the fare from distinct cross-town travel; $y$ = the cross-town transfer fares from passengers who would use the rapid transit system whether there were cross-town roads or not; $z$ = the similar fares from passengers who would not use the rapid transit system, were there no cross-town transfer fares; and $z'$ = the rapid transit profit from the latter class of passengers.

Adjusting the cross-town fares in such a manner that $x \times y \times z = \alpha$, it is evident that the cross-town roads could be provided and operated without cost, when $z' = i$. Whenever $z'$ (or $z'$ + any excess of $x \times y + z$ over $\alpha$) exceeds $i$, the cross-town roads would be a source of profit. It is probable that $z'$ would in time amount to several million dollars annually.

As a general rule, the distance which persons are willing to walk in the choice of a route of travel is inversely proportional to the distance which they wish to ride. The cross-town feeders, by inducing persons in all parts of the city to use the rapid transit railways, when desiring to travel from one and a half to four miles, would virtually increase the carrying capacity of these railways; because several of the passengers who pay the profit $z'$ would, in succession, occupy the same seat during one train trip.

Under the given condition of scaling down the fares of the cross-town roads until they pay no profit, it is unlikely that any transit company would provide them voluntarily; but considering that they cannot be a source of loss, and that without them no transit system can be generally satisfactory to the people, it seems reasonable to say that authority to construct rapid transit railways should carry with it obligation to provide a thorough system of cross-town roads.

When travel on the two suggested four-track railways shall have grown to their full capacity, so that a want begins to be felt for additional tracks, the number of passengers carried annually will be from three to four hundred millions; and the receipts from fares, fifteen to twenty million dollars, of which half may be required to pay the expenses of maintenance and operation.

The rapid transit line, if carried through the blocks, should be a tunnel rather than a viaduct, because, if it be intended to construct buildings and a railroad on a purchased right of way, it must be evident that more of the buildings can be made available for the use of tenants by placing the railroad underground than by running it, a story or more high, through the buildings. Moreover, a viaduct would not be a permanent way, since all the crossings of the transverse streets, amounting to some thirty per cent. of the road's whole length, must consist of perishable iron bridges. If it may be assumed that trains can be moved at fifty miles an hour, by some other motive power than fire-box locomotives, and that the buildings constructed over a tunnel will yield a profit in rentals, a tunnel through the blocks will, probably, be the most remunerative form of permanent way.

The construction account might be somewhat as follows:

Allowing 20 blocks to the mile, and four lots to the block, with 12 lots added for each of 18 intertrack stations, and eight lots for each of 64 side stations, the number of lots required amounts to 3,208. Averaging the value of improved and unimproved property, from the Battery to the Yonkers line, at $20,000 a lot (25 ft. by 100 ft.), the cost of 3,208 lots would be $64,160,000.

| | |
|---|---|
| One quarter of this amount for right of way of railroad | $16,000,000 |
| Thirty-one miles of tunnel at $2,000,000. | 62,000,000 |
| Stations, equipment, cross-town lines, etc. | 25,000,000 |
| Cost of transit system | $103,000,000 |

Whoever is familiar with the subject can now estimate the cost and profit from rentals of 3,208 fireproof buildings (25 ft. × 100 ft.), constructed on top of the tunnel, and occupying sites costing $48,160,000. Except in places where the grade of the tunnel is laid at some distance from the surface (as may frequently be the case at points remote from the stations), the buildings will have no floor lower than the street level; and a public footway, 15 or more feet wide, must be provided, if not through all the blocks, at least through each block where a station entrance is located. The stations would be entered from this footway, and the exits debouch upon the cross-town streets.

The transit plan thus far outlined is sufficiently explained to admit of its being intelligently criticized. It is, at least, the only plan ever proposed to provide the whole city with transit facilities. The desired object is thus far attained that, were the system in operation, every person in the city would be within five minutes' walk of a transit line, which would always be the route to any desired point. If, instead of striving for unity of design, encouragement and assistance be given to those transit companies who propose, severally, to build longitudinal railways through the east side, the west side, and the center of town, the result will finally be a heterogeneous system, costing more than two lines with feeders, and satisfying only a part of the public. The general plan of concentrating rapid transit travel on a few lines of large capacity, by means of cross-town surface roads as feeders, was devised by the writer, as the best possible solution of the transit problem, and first published by him in 1874. A few of the paragraphs in this article are taken from a transit paper of his, printed, a few months ago, in *The Engineering and Mining Journal*.

It is a vicious principle for a municipality to sell the franchise of a transit line, or to require from a transit company any other payment than just taxes on the property whose title the company acquires; because it is a matter of public interest to add no unnecessary item of cost to either the capital account or working expenses, to the end that the fare may be low and the service as efficient as possible.

But the question whether the transit system shall be built by the city or by an association of capitalists, still remains unsettled. If, as many persons believe, perhaps with truth, that railways cannot be constructed or operated as cheaply by the city as by an independent transit company, it is also true that the city has advantages over a transit company as a borrower of money. Efficient treatment of the question would be to draw up a comprehensive specification, showing the number, extent, location, and character of the roads proposed, the sites and minimum dimensions of the station platforms, the least allowable number of trains and cars to be run over the whole of their respective routes during each hour of the day, the habitual average speeds required, and the rates of fare; and then to offer the franchise to any association of capitalists who will obligate themselves to observe the given requirements. But if—as seems quite possible—careful estimates shall show that the receipts from a four-track permanent way, extending the whole length of the city, will not suffice to do greatly more than pay the maintenance and running accounts and interest charges, the offered franchise will find no takers. In this contingency, the city, by constructing and operating the roads, might realize a sufficient profit from increase in taxable values; and the more nearly the transit system succeeds in making travel easy, rapid, and cheap between every two points within the corporate limits, the greater will this profit be. If, then, the alternatives should be, on the one hand, either no transit system at all, or one cheapened at the expense of being unsatisfactory to the people; and on the other hand, an adequate transit system constructed by the city and profitable to it—are they good citizens who would oppose themselves to the city's building such a system?

What the transit problem needs, at the present time, is the appointment of a board of distinguished and disinterested railway engineers, to collect statistics, make surveys, and draw up a specification of the roads required, with detailed estimates of cost. The making of the plan is work which requires no legislation; and no attempt should be made to fit the plan to the requirements of any existing law. It is the people who make the laws and in any question involving the practicability of a work whose sole legitimate object is to satisfy the people, it is their right to insist on whatever enabling legislation is necessary. Experience shows that public sentiment will not endorse an attempt to secure transit legislation, if the plan be not specified; because no one can tell what kind of a railway system would eventually, be evolved. Both the general transit bill of Mayor HEWITT and that of Mayor GRANT had more enemies than friends, and came to naught. Probably, no such bill can be passed without having amendments tacked on of a kind to render the making of a really adequate plan impossible. But it cannot be doubted that the voice of the people would be heard in favor of legislation authorizing a plan of which it could be said: "This is the best plan which the best engineering talent attainable, the whole transit question being considered on its merits, in the interest of the public, is able to produce."

The Mayor of New York, the Real Estate Exchange or any other body of prominent men, might render the city a great service by at once employing eminent engineers to deal with the technical parts of the transit problem. Non-expert commissioners are not well qualified to do this work; nor can engineers—however competent—produce a thoroughly defensible plan if they are hampered by any other instructions than to treat the question on its merits.

Another mode of procedure, not, perhaps, altogether Utopian, would be for the Governor to convene the Legislature, immediately, in extra session, for the purpose of authorizing the appointment of an engineering commission, to report a complete transit plan to the Mayor on or before Jan. 1, 1890; the Mayor being then required to draw up and submit to the Legislature whatever bills may be necessary to enable the carrying out of the plans.

If no present attempt be made to concentrate public attention on a well-considered plan, transit legislation next winter will probably be controlled by organized forces, to whom the interests of the people will be among the least of considerations. Promptitude of action is desirable.

> Thrice is he armed who hath his quarrel just,
> And four times he who gets his blow in fust.

NEW YORK, July 20, 1889.

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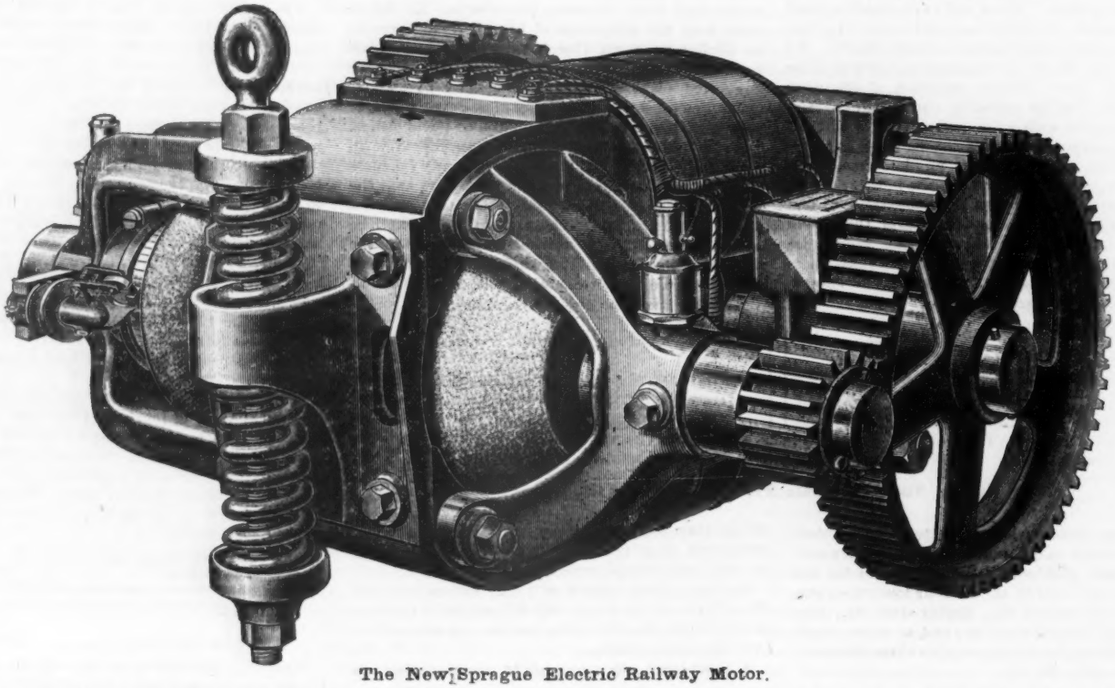
THE OHIO & NORTHWESTERN RAILROAD, on which a serious accident occurred last week by the giving way of a trestle at Batavia, is 102 miles in length. There are in this distance 175 trestles with a total length of 30,941 ft., nearly 6 miles. The road was widened to standard gauge two years ago.

## The Sprague Improved Electric Railway Motor.

We publish in this issue views of the Sprague improved electric motor for street railway work. This motor represents the experience of several years in the electric street railway business, and it is intended to meet all the exigencies in this kind of work. In its manufacture every detail of mechanical and electrical construction is carefully attended to, and the most recent improvements which experience could suggest have been adopted to meet the necessities of street-car service.

Only one intermediate shaft is used between the armature pinion and the main gear, and the entire reduction is about 12 to 1. All the gears and every part of the motor are made extremely strong and durable, as can be seen in the case of the gears in the engraving, where the general appearance of durability and strength is everyw



The New Sprague Electric Railway Motor.

The main gears are of the split gear pattern, so that in case of necessity they can be easily removed from the shaft without dismounting the machine. The pinion and all the bearings are also constructed so that they can be easily removed, if necessary.

Great attention has been paid in this motor to obtain a machine which will require a minimum amount of attention and care and other unfavorable conditions, which motors for street railways very often work under in actual practice. For this reason, all the bearings are made completely dust-proof and very durable. The armatures are of the same type; have been proved to be water-proof and incapable of injury by moisture. In a recent test of these armatures, made at the Sprague factory at Schenectady, one of the armatures was placed successively in a tub of fresh water and allowed to remain there for 24 hours, and in a tub of salt water and allowed to remain there for the same time. After each of these baths, the armature was placed in position in the motor and the machine was worked to one-third above its normal load as measured by a dynamometer for several hours without developing any trouble whatever. These tests proved most conclusively that these machines can be relied upon under all conditions of weather, and that they cannot be harmed by moisture or by water splashing upon them from the road-bed.

Another important improvement which has been adopted in this machine is that the field magnet coils are completely incased in covers, as shown in the engravings, which fully protect the wire from all outside damage; these casings are hermetically closed, so that it is impossible for moisture to affect the coils in any way.

The style of brushes used upon these motors is of a new design, which has been shown to give excellent results in this kind of work. These brushes, instead of cutting the surface of the commutator, as brushes made of copper and other materials have been proved to do, keep the commutators smooth, at the same time giving very good electrical connection. The Sprague method of flexibly suspending the motors, and of controlling the speed of the motor without the use of any wasteful resistances, is also in use with these motors, upon all the roads installed by the Sprague Electric Railway & Motor Company.

A great deal of attention has been paid to the design of this motor, and great care has been taken to secure durability and strength, while reducing the weight to a minimum. For this purpose, and with this object in view, cast-iron has been dispensed with in the cores and yoke of the field magnets and wrought iron substituted. Other details of construction and design have been adopted upon this machine, for the purpose and with the view of making this machine superior to any other electric motor designed for the same work.

These motors are already in operation at Wichita, Kansas; Marlboro, Mass.; Cleveland and Cincinnati, Ohio; Erie, Pa.; Atlantic City, N. J.; and at one or two other places where they have been installed. They have been found to give very good results, and in the future this type of motor will be used in all of the Sprague electric railway installations.

## Common Road Law of the State of New Jersey.

The State of New Jersey being foremost in the construction and maintenance of its highways, we give the text of the latest law on this subject as passed this year. It is entitled, "An Act to enable Boards of Chosen Freeholders to acquire, improve, and maintain Public Roads," and its full text is as follows:

1. Be it enacted *by the Senate and General Assembly of the State of New Jersey*: That it shall be lawful for the board of chosen freeholders of any county in this State to acquire, improve, maintain, and assume full and exclusive control of any public road or roads or parts thereof in their county, so far as may be necessary for the purpose of improving and maintaining the same as a road or roads for carriages or other vehicles, but for no other purpose, except such roads or avenues as are now under the control of any county road board; that in order to acquire and assume such control in any county with power to improve and maintain the same, the said board shall cause a map to be made, or adopt a map already made, on which the principal public roads or highways of the county shall be, or are, laid down, and shall cause the roads or parts of roads which the said board intend to acquire and assume such control of to be plainly indicated thereon, and shall file the said map, when so marked, in the office of the clerk of the county; whereupon the roads or parts of roads so marked or indicated on the said map shall become and be known as "county roads," and shall hereafter be improved, maintained, and kept in a safe and convenient condition for public use as aforesaid, exclusively, in the manner provided in this act; and it shall be lawful for the said boards to relinquish control of any road or part of any road so acquired and marked, and to acquire and assume control of other roads or parts of roads in the county, from time to time, with the same power to improve and maintain the same; in either of which cases the said map shall be changed accordingly. In acquiring or assuming control of any public road, or relinquishing the same, the said board shall accurately describe such road in a written resolution, and file a copy thereof, certified by the clerk of the board, in the office of the county clerk, who shall record the same in a book to be provided and kept for that purpose; the term "road," as used in this act, shall be construed to include street, avenue or other public highway.

2. *And be it enacted*: That it shall be lawful for the board of chosen freeholders to cause the said county roads, or any part thereof, to be graded, paved with Telford, macadamized, or otherwise improved by means of stone or gravel, for a width of at least twelve feet in the center thereof, wherever such improvement may be required to keep the same constantly in good condition; all such pavements or other improvements (except repairs costing not more than one hundred dollars) shall be done under contract with said board; but no contract for any such work shall be awarded, or be valid for any purpose if awarded, unless a notice specifying the work and materials, and inviting bids or propositions to do or furnish the same, shall have been published for at least three weeks, at least once in each week, in two newspapers published and circulating in the county, and representing different political parties. Every contract made for improving any county road, or part thereof, shall be based upon carefully prepared specifications of the work and materials required, to which reference shall be expressly made in the contract, and no money shall be paid for any work done or materials furnished unless the same shall have been done or furnished in strict conformity to the terms of the contract and specifications; and no contract shall be awarded, or be valid for any purpose, if awarded, unless the person or party whose bid or proposition is accepted shall, at the time of signing the contract, execute a bond to the board with sufficient surety, to be approved by the county collector, conditioned for the faithful performance of the contract; the penal sum of such bond shall be at least one-half the amount of the contract price for the work and materials; all such contracts and bonds shall be held by the county collector; the said board may give the notice aforesaid and award contracts for parts or sections of the improvements intended to be made.

3. *And be it enacted*: That it shall be lawful for the board of chosen freeholders to cause a special tax to be levied, which shall not, in any one year, exceed the sum of twenty-five thousand dollars, nor one-fourth of one per cent. of the assessed value of the taxable property in the county, or to issue bonds of the county, bearing interest at not more than five per cent. per annum, to be known as county road bonds, for the purpose of raising money to pay the cost, or any part of the cost, of paving, macadamizing or otherwise improving the said county roads, or any part thereof, in the manner aforesaid; but prior to the issuing of any such bonds the said board shall make an application to the circuit court of the county, in writing, setting forth the assessed value of the real estate therein for the purpose of taxation in the year next preceding, together with a statement of the entire debt of the county for all purposes, and of the amount of county road bonds which they propose at that time to issue; whereupon the said court shall fix a time to hear such application, whereof such notice, by publication, shall be given as the court shall direct; and at the time and place so fixed the said court shall proceed in a summary manner to investigate the accuracy of the statements contained in the said application, and shall make a certificate setting forth the assessed value of the real estate in the county for the purpose aforesaid in the year next preceding, and the total amount of the debt of the county for all purposes as found by such investigation, which certificate shall be entered at length on the minutes of the court and filed in the office of the clerk of the county; and no county road bonds shall be issued to such an amount as, in addition to existing debt, shall raise the debt of the county for all purposes above three per cent. of the assessed value of the real estate therein, as such debt and assessed value of real estate are shown by such certificate; and in case any such bonds shall be issued in excess of the limit aforesaid, all such bonds so issued in excess shall be void in the hands of any person or party, notwithstanding any recitals therein, or any representations that may be made concerning the same; such application must be repeated in case of every other proposed issue of such bonds; but in no case shall any such board issue bonds under this act so that the amount of such bonds out standing at any one time shall exceed the sum of one hundred and fifty thousand dollars.

4. *And be it enacted*: That one-third of the expense of paving or otherwise improving any county road, or any part thereof, in the manner aforesaid, shall be paid by the cities, towns, townships or boroughs in or through which any such pavement or improvement shall be made, in amounts in proportion to the cost of any such pavement or improvement in each city, town, township or borough; but nothing herein shall be construed to exempt any such city, town, township or borough from liability to pay its share of the remaining two-thirds of such cost and interest; and it is hereby made the duty of the officers, boards or bodies authorized to levy taxes for county purposes, to assess and levy upon the taxable property in the respective taxing districts of the county, such sum or sums of money as may be required, and not otherwise provided, to pay the amount of the cost of making any such pavement or other improvement, or the interest thereon, that may be due, or coming due, during the current fiscal year of the county, and to assess and levy upon the taxable property of any city, town, township or borough in the county wherein any county road shall have been improved under this act, such sum or sums of money as may be required from time to time to pay the respective proportions of any such city, town, township or borough, of the amount of such cost, or to reimburse the county, to the extent of one-third of the cost of any such improvement made therein, with interest; said sum or sums of money shall be assessed, levied and collected at the same time, in the same manner and by the same officers that other taxes for county purposes are or may be assessed, levied and collected; and when collected the same shall be paid over to the collector of the county, to be applied exclusively to the objects or purposes for which the same were levied.

5. *And be it enacted*: That the board of chosen freeholders shall employ a competent engineer, at a reasonable compensation, to survey the county roads or any part thereof, when necessary; to prepare specifications for pavements or other improvements intended to be made in pursuance of this act, and to supervise the work and materials used. After such improvements or any part thereof shall have been completed, the same shall be kept in repair at the expense of the county, and some competent person shall be employed by said board annually, at a fixed compensation, to inspect the condition of the county roads, from time to time, so far as the same may have been improved, and such inspector shall have power to cause necessary repairs to be made to the pavement or other improvements made under this act, provided the cost of any of such repairs shall not exceed fifty dollars, and not more than one hundred and fifty dollars shall be expended by the inspector in any city, town, township or borough in any year; repairs costing more than fifty and not more than one hundred dollars shall be made only by authority of a committee of the said board, and repairs costing more than one hundred dollars shall only be made by direct authority of said board; all bills or claims for making repairs or furnishing materials therefor, after being approved by the inspector, shall be rendered to the said parties who performed the work or furnished the materials used or to be used; and no bills or claims for repairs shall be paid unless the same shall have been made strictly according to the provisions and directions of this act; no tax shall be levied for the purpose of repairs, in any one year, in excess of three per cent. of the costs of the improvements made; the inspector, immediately after his appointment, shall give a bond to the said board in the penal sum of two thousand dollars, to be approved and held by the county collector, conditioned for the faithful performance of his duties.

6. *And be it enacted*: That all roads marked or indicated as county roads on the map or maps mentioned in the first section of this act, shall be kept in repair by the local authorities of the cities, towns, townships or boroughs in and through which they extend, until such roads shall have been actually improved by the board of chosen freeholders of the county, as provided in this act; but in cases where part of said roads shall have been actually improved under this act, only the unimproved part shall be kept in repair by such local authorities.

7. *And be it enacted*: That nothing in this act shall be construed to repeal, or in anywise affect the act constituting "the Essex Public Road Board," approved March 31, one thousand eight hundred and sixty-nine, or any supplement thereto, or any act amendatory thereof, or relating or applicable thereto.

8. *And be it enacted*: That this act shall take effect immediately.

## Test of the Suitability of Puddle Wall Material.

A correspondent has asked this journal to give him "a cheap test of clay, as to its suitability for puddle walls for reservoir dams." This query is answered practically as follows, by Hon. WM. J. MCALPINE, Hon. Mem. Am. Soc. C. E., whose long experience in work of this nature makes him an undoubted authority.

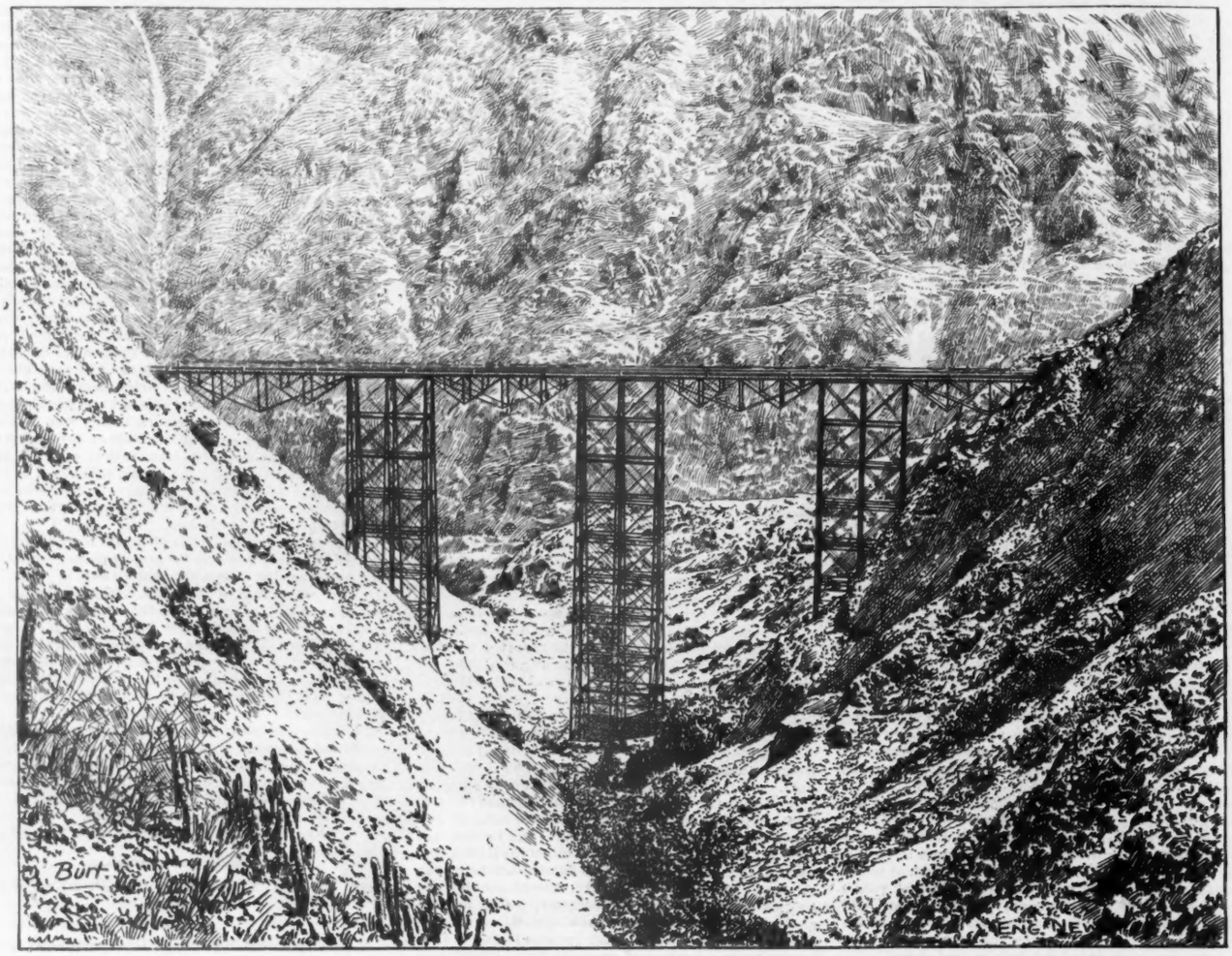
Thoroughly dissolve a given piece of the earth to be tested in water; agitate the vessel, and let the colored water gradually flow off until that which remains has but little color. The residue will be sand, gravel, and stone, and its dried weight deducted from the dried weight of the original mass will be that of the very fine material, viz., clay, loam, or vegetable matter, once in the mass.

The object in making such a test is to find these proportions; for a water-tight material is formed by thoroughly mixing ingredients of different degrees of fineness in such proportions that the interstices of the coarser are all filled by the particles of the finer material. This is the natural condition of most clays, but it is not absolutely necessary that the "clay" puddle wall should be used.

A water-tight dam may be made without clay, that is, with coarse and fine gravel and sand, provided the sand is very fine; but the dimensions of the dam must be increased. Mr. GEORGE H. NORMAN, M. Am. Soc. C. E., made a perfectly water-tight reservoir dam, at Newport, R. I., entirely of sea-washed beach sand, in grades varying from coarse to very fine; but he nearly doubled the width of the banks over the dimensions called for by ordinary practice.

As Mr. MCALPINE lately remarked in this journal,

and for the reasons there stated (see ENGINEERING NEWS, Nov. 17, 1888), he would avoid "puddle walls" altogether, and regards it as very much better practice to mix the water-tight material throughout the half of the dam lying next to the water, making it all homogeneous. If this is well done, the puddle wall is not needed; and if the puddle wall is the only really impervious part of the dam, there are a number of chances for failure. As a rule, however, impervious connections between the natural and artificial earths, at the bottom and the ends of the bank, are generally of more importance than the composition of the artificial bank itself.




The Verrugas Viaduct before its Destruction. From a Photograph.

## The Verrugas Viaduct.

The accompanying view of this famous viaduct is from a photograph taken shortly before its partial destruction by flood some months ago, and clearly shows the cause of the failure. We give also a view on the Lima & Oroya Railway in its passage through a gorge a short distance below the viaduct, showing the general character of the country through which it runs, and about the lightest of the work on that enormously heavy line. The mountains around the Verrugas viaduct rise with equal abruptness to equally enormous heights, although only the lower parts of them are visible in the cut.

The Verrugas viaduct is 52 miles from Callao and 5,836 ft. above the sea. It was built in 1872 by the Baltimore Bridge Co. Mr. L L. BUCK was resident engineer in charge and distinguished himself by devising a very rapid and effective system of erection. The central pier, which has gone out, was 252 ft. in height, the others being 146 ft. and 179 ft. respectively. The total length of the bridge was 575 ft. Much of the material for the bridge and all for the construction of the road had to be hauled ahead on mule-back, more than 1,500 mules being employed, of which 10 or 12 were lost daily by falling from the narrow mule-tracks into the gorges below. In the view of one of the gorges of the line shown in the accompanying cut can be still traced one of these old mule trails high on the slope. These trails alone cost more per mile than the grading of a fairly heavy American road.

The erection of the Verrugas viaduct was accomplished by the aid of 8 wire cables, grouped four together, on which the separate pieces were handled by an improvised equivalent for the now familiar cable transport system, but then first used for such a purpose. In three months after erection began, trains were running over it. Not a single life was lost in erection, except those from disease, the terrible Verrugas fever, peculiar to the locality, having carried off many obliged to stop there. The total cost of the work erected was about $360,000.

The storm by which the viaduct was destroyed was somewhat phenomenal, and caused the washing out of a number of other lower bridges, chiefly of French construction. The failures, however, were due entirely to washing out of masonry piers, and not to defects of the structure, while the fall of the Verrugas is clearly traceable to the error of design in putting the main pier right in the center of a narrow gorge, and to nothing else. An unusually heavy rain, but yet, we judge from the accounts, what would be in any other but this usually dry region a rather moderate fall, fell over the whole upper water-shed, gathered in the narrow gorge in volume sufficient to push ahead of it loose rocks and trees, which formed a number of temporary dams holding the water until it had gathered greater force. The gorge had a grade of about 16 per cent. and some vast masses of rock, estimated to weigh 50 tons, were rolled along by it.

There could be but one end when the viaduct was struck by this torrent. By the regrettable error of design alluded to, which after the event seems to show a strange lack of foresight, and which in any case may be taken as a warning, the main central pier stood squarely in the center of the narrow gorge and completely blocked it up. The pier resisted the mass of water, rock, and timber an instant, forming a new dam, but almost immediately gave way, carrying with it the two adjacent spans, and so great was the force of the torrent that a large part of the metallic débris was carried several hundred metres down stream before it finally lodged.

Had the viaduct been constructed originally with either 3 or 5 spans instead of 4, so as to leave the central gorge unobstructed, there is no reason to doubt that it would have escaped them altogether, besides being more correct architecturally, since it is an accepted canon of design that for the best artistic effect there must always be a central span in a viaduct, and never a central pier; in other words, the number of spans should always be 1, 3, 5, 7, etc., and never 2, 4, 6, etc., if it is possible to avoid it.

Another of the minor structures carried away testifies to the fact that this law originated in sound technical reasons, and not merely in effect upon the eye. A two-span iron bridge had its central pier, naturally, about where the greatest rush of water comes. This pier was carried out, and with it both the spans resting on it, although it does not appear that the trusses themselves were at any time in danger.

The photograph from which our engraving was prepared was taken but a few days before the disaster, and was sent us by an engineer who has since visited the site. It is from data given by him as well as from accounts in the local press that we have been able to prepare this account. The whole injury to the viaduct is confined to the central pier and two adjacent spans, which have been carried

away completely. The two side piers and two end spans stand wholly uninjured. Since the disaster a wire rope bridge has been run across to connect the piers, but the road is otherwise so demoralized that it is calculated it will take about $2,000,000 to put it in order again, and the traffic has not been heavy enough to warrant the hope that this will be done very soon. If the viaduct is renewed, the probabilities are that the error of a central pier will be avoided at whatever cost to the appearance of the structure.

**A View on the Lima & Oraya Railway, Peru, From a Photograph.**

## A Decade of Progress in Electricity.

In reviewing the advances made in electrical science and the great variety of purposes for which applied electricity has been adapted, one is at a loss where to begin. For, just as fifty years ago the development of the then new power of steam absorbed the attention of the scientific and practical world, so has the bringing into use in an almost endless number of applications of the more concentrated and subtler force of electricity engaged the attention of thousands for the last decade and with wonderful practical results. It seems as though, no matter what department of mechanical science one touches where energy is employed, one cannot go far before finding the agency of electricity utilized. It already penetrates and permeates nearly every branch of applied science. There can be no doubt that this is the age of electricity, as in times past in the world's history, stone, bronze, iron, and steel ages have existed. The past decade has witnessed almost the entire development to its present extent of the telephone, electric lighting, both arc and incandescent, and the application of electricity as a motive power to electric railways. The papers and discussions of the National Electric Light Association, the electric clubs, and of other engineering and scientific societies, have produced a great amount of recorded experience which already causes electric literature to overshadow that of many of the important branches of engineering.

Of course the knowledge that the force or agent of electricity and that of magnetism existed is old, dating from the year 1600. Discoveries and experiments were made at intervals, though hardly more than laboratory experiments, until Morse's first telegraph line, from Washington to Baltimore, built in 1844, marked the first application of electricity on a commercial and practical basis. The principal discoveries and inventions were the first frictional electric machine, made by VON GUERICKE in 1660; FRANKLIN'S idea of the identity of the electrical fluid with lightning, in 1749; GALVANI'S discovery of galvanic action, in 1786-89; the first production of the electric light by DAVY batteries, in 1808; electro-magnetism, discovered by OERSTED, in 1819; the first electro-magnet, made by STURGEON in 1824 and improved by Prof. HENRY in 1829. FARADAY laid the foundation, over fifty years ago, of modern electrical science. He was the first, in 1821, to cause a magnet to revolve through the action of an electric current. In 1831 he discovered the principle of induction, or the production of electricity by magnets, on which principle all modern electrical engineering is based.

The first telegraph, from Paddington to Drayton, England, dated from 1835; the first in America, from Washington to Baltimore, was operated May 27, 1844.

In 1834 DAVENPORT made and used the first American electric motor. The Daniell cell or chemical battery dates from 1836; electrotyping from 1840; the Bronson battery, from 1842. The first magneto electric machine was constructed by F. NOLLETT at Paris, about the year 1850. The first Atlantic telegraph cable was laid in 1858; the Gramme dynamo dates from 1869-71; duplex telegraphy, from 1872; and Edison's quadruplex system, from 1874; the first exhibition of the Bell telephone, 1876; and the Edison incandescent lamp, from 1879.

The decade from 1879 to 1889 has witnessed the most wonderful developments of these germ ideas. To render the results now obtained at all possible, it was necessary to use as the basis the previously developed power of steam, as obtained from the combined use of the steam boiler and perfected steam engine. Coal, containing great quantities of stored energy, has always been one of the principal sources of power, and the electric dynamo enabled the power so generated in the steam engine, and delivered to it in the form of a continuous motion, by rotating the armature, to be converted into the electric current, continuous or alternating, and which, carried by wire to any point desired, could yield power again in quantities large or small, and in any of the varied forms required in practical use.

Among the first applications was the development of the arc light. In 1878 the Jablochkoff candle was first successfully employed for lighting streets in Paris. In the same year the Sawyer-Mann electric lamp was introduced in the United States. Soon, in all the cities of the civilized world the electric arc light for street lighting began to appear and to displace the cruder contrivance, gas. For stores, halls, and in general all places for public use, the improved light was speedily adopted.

Meanwhile many were at work upon the problem of subdividing the electric current so as to obtain the light in smaller quantities, and the incandescent lighting system began to be developed. EDISON established the first central station for general incandescent lighting in New York City, in September, 1882. This light is now coming into general use in offices, cars, and steamers for passenger transportation and for private residences, and makes the most approved light in existence to-day, in respect to convenience, quality of light, and freedom from the objections of heating and vitiation of the air of rooms, common to other methods of lighting. As an indication of the endeavors made for improved methods of lighting, it may be stated that there were 184 patents issued by the United States on electric lighting alone, last year. In Massachusetts there are 69 gas companies with an aggregate capital of $12,194,000. The electric light companies of the State number 84, with $3,572,780 aggregate capital, showing that in addition to the business previously done by the gas companies, the electric lighting interest has already grown to more than one-quarter part the entire extent of that of the older companies.

In New York State there are 92 electric light companies with a capital of $122,445,000. Since the establishment of electric lighting, the price of gas, which averaged for 200 cities $3.15 per 1,000 cu. ft. in 1878, has fallen to $2, as determined from the average price for the same cities, in 1887, a decrease of 33 per cent in nine years. The cost of electric lighting itself has also diminished in like proportion. Carbons have fallen in price from $50 and $60 to $8 and $10. The largest electric lighting plant in the world is now under construction in London, by the London Electric Supply Corporation. The total capacity will be 450,000, or nearly a half million of lights, of which number 33,000 lamps are now in operation. These lamps are to comprise 250,000 of 10 candle power each, and are to be maintained with a pressure or potential of 10,000 volts in the main wires. It is stated that the coal required for 100,000 lights of 10 candle power each is 100 tons per day of 10 hours.

The application of the electric light for lighthouse illumination early received attention. It has been

so employed in France, but it is said has not developed marked increase of power or range on the best oil lights in use.

An important application has been the adoption, now becoming general, of the electric incandescent light in mills and factories. It possesses advantages in furnishing a better light, and making more perfect production in certain kinds of goods possible, as well as in its superiority over the gas formerly used, in the matter of the health of employés.

While motors for generating small quantities of power for miscellaneous uses were soon manufactured and numbers of them applied to running elevators, sewing machines, printing presses, and the like, the great need of appiying some form of mechanical power to supersede horses, successfully, for the transportation of city and surburban populations led to endeavors by SIEMENS, DAFT, EDISON, VAN DEPOELE, SPRAGUE, BENTLEY & KNIGHT, THOMSON, and others, to produce an efficient and satisfactory electric motor for railways. The idea was proposed by Dr. WERNER SIEMENS in Paris, in 1867, and in 1879 a model was operated at a Berlin exhibition. EDISON ran an electric locomotive at Menlo Park, N. J., in 1880, transmitting the current through the rails. Electric railways were introduced in various parts of Europe during the next two or three years.

The first electric railway in the United States was put in operation at an exhibition at Chicago, in February, 1883, upon the Van Depoele system. The Daft electric locomotive, "Ampere," was run upon the Saratoga & Mount McGregor Railroad in November, 1883.

In 1886 there were in Europe 11 electric railways, and in the United States about 12, nearly all of which had been built within the previous two years. At the end of 1887, the number in operation in this country had increased to 30, and this number doubled in the next 10 months. So rapidly is this development taking place that to-day there are 72 electric street railways in use, comprising over 400 miles of line and 600 motor cars. Sixty-two more are under contract for building, while, it is estimated, more than 1,000 cars are now being equipped with the electric motor.

The West End Street Railway Co., of Boston, Mass., now the largest street railway in the world, is about to equip its entire extent of 210 miles of track with the electric power, at a cost for the whole system of about $3,000,000. From the experience thus far obtained on this railway, it is stated that the adoption of the electric power has effected a saving in time, on an average, of 30 per cent., as compared with horses.

The longest electric road yet built, the Topeka Rapid Transit Railway, of Topeka, Kan., comprises 14 miles of line and 20 miles of track, and was opened April 3, 1889. The power plant comprises 5 steam boilers, one engine of 600 and one of 300 H P., and 5 Thomson-Houston generators of 80 H. P. each. Twelve cars are equipped each with two 10 H. P. motors.

It is estimated that to supply a complete electric service on our street railways will require the expenditure of $1,000,000,000.

To guard against the detrimental effect of electricity upon watches, non-magneticwatches are nowmade with springs and balance wheels of a metal unaffected by the currents, in place of the use of steel.

The question of placing all electric light, telegraph, and street railway wires underground has been greatly agitated during the last two or three years. Wires placed in underground conduits do not operate as successfully as do overhead wires. For some purposes this can doubtless be done, but the underground conduit for street railway power purposes has thus far practically failed.

The first long distance transmission of electric power was made by DEPREZ between Munich and Miesbach, and exhibited at the Munich Exposition in 1882, transmitting power for 37 miles or through a metallic circuit of 72 miles. Power was transmitted between Crenil and Paris, 34 miles, in 1885.

While these developments of great extent and far-reaching consequences are taking place, the use of electricity in railroading, for signalling and telegraphing, has by no means diminished. Progress has been made from the simple Morse telegraph to the writing, printing, and stock-reporting instruments, duplex, quadruplex, and multiplex telegraphy has been developed, by which a large number of messages may be transmitted simultaneously over the same wire without confusion.

In 1886 the Phelps and Edison system for telegraphing to and from moving transit was operated.

Electricity is being extensively introduced for coast and harbor defence and in marine gunnery.

The telephone has received almost its entire development as a commercial institution during the past decade. First exhibited by BELL at the Centennial Exhibition in July, 1876, it was operated for practical purposes May 14, 1877, and became at once practically successful.

The total number of exchanges of the American Bell Telephone Co. is now 742, and of branch offices 452. The total number of miles of wire in 1889 is 170,471, an increase of 24,033 over the previous year. The number of employés is 6,310, of subscribers, 171,454, the last number being an increase of 12,742 over the previous year. The number of instruments in use is 411,511, an increase of 31,234 during the year. The number of exchange connections made daily in the United States is estimated at 1,051,566, or a total per year of 383,821,590.

The long-distance telephone, operating with a quantity of electricity almost too small to be measured, and yet so perfectly that a whisper can be transmitted for such distances as that from Boston to Philadelphia, preserving the characteristics of the sending voice, is taking a permanent place among the facilities required in the business community and is receiving a steady development.

The microphone, an instrument by which minute sounds can be so magnified that previously inaudible movements, such as the footfall of a fly, can be heard, was invented by Prof. HUGHES, of London, and is similar, in its operation by minute quantities of electricity, to the telephone, which invention it followed.

Electric welding, invented by ELISHA THOMPSON, after much labor expended upon the designing and perfecting of the machines during the past two years, is being introduced as a practical agent in the metal manufactures, and in range of metals and applications to purposes of almost endless variety is accomplishing results never before attained in this department of useful arts. The discovery has resulted that all metals can be molded, whereas it was previously supposed that this property was confined to a narrow range of metals.

Electric smelting, especially for the cheap production of the useful metal, aluminum, in its alloys has been in practical use for several years. The electric fire alarm and police call systems have been projected. Electric telepherage, or transportation of articles of comparatively light weight, such as the mails, has been in use in England, and a new magnetic system, called the Portelectric system, has been proposed in this country.

The phonograph, which has lain practically dormant since its invention by EDISON in the spring of 1877, has been perfected and is about to be placed on the market, to be operated by the electric motor, for purposes of business and other correspondence.

The electric-matrix printing machine is designed to dispense with the tedious operations of type setting and distributing, and to employ the agency of electricity in the art of printing.

The electric light is finding an application in photography. An omnibus propelled by electricity is in operation in London.

Electrotyping has been generally introduced and is an essential requisite for the cheap production of cuts and book plates,

Electricity is being applied in plumbing. Its use in mining, both for applying lighting to the immediate locality desired, and for the transmission of power to operate drills and convey materials, is being extended, and will doubtless effect an important improvement in mining operations in the near future Electric blasting is in general use.

Electric meters are now in use, and it is thought that in various ways the agency of electricity is capable of furnishing a more accurate and less variable standard than by any other method of measuring.

Electric heating has been suggested, but its development for practical purposes is yet a problem for the future.

Among the most recent applications proposed is that of fire extinguishing by means of the electric motor. By the method suggested, the cumbersome steam fire engines will be superseded, and a portable electric motor taken to the hydrant, where it will be connected to a permanent wire, by which power for its operation will be obtained from the central station.

In surgery, electricity is used for cauterizing wounds and as an amputating knife by using a loop of wire heated by the current to incandescence. In 1882 BELL adapted Prof. HUGHES' invention of the induction balance, by which the location of masses of metal in the body can be determined, and it has been applied in locating bullets or foreign substances buried in the human body.

Use has been made of electricity for capital punishment recently in New York State, and its general adoption for such purposes is thought by some to be probable.

The utilization of other powers than that of coal is being attempted through the agency of electricity. Tide and wave motors, windmills, water powers, etc., are to be used for generating the electric current, which may be stored or transmitted by wire for immediate use at any point where it may be required. The utilization of the vast power of Niagara river above the falls, for lighting, as a motive power, and for transportation throughout New York and adjoining States has been under contemplation for some years, and the project appears to grow more feasible with each improvement made in efficiency of electric apparatus.

Thermo-electricity, or the production of electricity directly from coal, by heating the point of junction of two metals of differing conductivity, which creates the electric current, has received scientific attention and study, but has not thus far been practically applied, although working models, called pyromagnetic motors, on this principle have been made and operated. It would seem that the list of new applications of electricity could be indefinitely extended; but with this glance only at the main lines of electric progress of the past decade, slighting, of necessity, important uses of unknown future consequences to us and to civilization, we see much remaining undeveloped, or in an embryotic state, ideas, suggestions only, which will unquestionably require the work of development in the future. This great agency pervades the whole earth. What it is, whether a substance, a fluid, a force, a current of magnetism, or a mode of motion, no one has yet determined. As in the case of heat, we are learning its mode of action and relations to other forces, and how portions of it can be separated so as to give a pressure or potential, by which a current can be produced that will perform useful work. Probably to-day as much is known of absolute knowledge concerning electricity as has ever been known concerning heat. It is more important to know about it and what can be done with it than to know what its nature is, and this is the direction in which improvement lies. Every day new uses are being found, and the results to follow will correspond to the needs of practical life.

## Relative Frequency of Letters and Combinations.

A correspondent in a late number of *Science* speaks as follows of the relative frequency of letters and combinations: In a recent number of the *Phonographic World* a correspondent asks, "In English composition (1), what is the relative frequency of the occurrence of the various letters of the alphabet; (2) in what proportion does each letter precede and follow each other letter of the alphabet; and (3) what syllables occur the most?"

In answer to the first question, it may be stated that in a font of type for printer's use, as supplied by type-founders, the different letters are usually supplied in about the following proportion: *e*, 1,200; *t*, 900; *i*, 865; *a*, 850; *n*, *o*, and *s*, 800 each; *h*, 640; *r*, 620; *f*, 450; *d*, 440; *l*, 400; *u*, 340; *c* and *m*, 300 each; *w* and *y*, 200 each; *g* and *p*, 170 each; *b*, 160; *v*, 120; *k*, 80; *q*, 50; *j* and *x*, 40 each; *z*, 20.

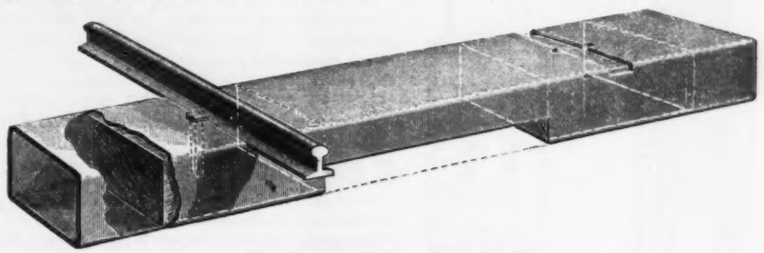
Some years ago I undertook to analyze 10,000 words of every-day English, from the editorial colums of twenty leading dailies, 500 words from each, selected from articles in which no undue prominence appeared to be given to any particular word. My object was to ascertain what combinations of two or more letters occurred with greatest frequency. My eyesight failed before my task was half completed; but the result of my labors, as far

as they went, may be of interest in connection with the foregoing questions. In 3,500 words, as far as analysis extended, I found that two-letter combinations occurred as follows:—

| Times. | | Times. | | Times. | | Times. | |
|---|---|---|---|---|---|---|---|
| th..... | 605 | is..... | 175 | as..... | 111 | me..... | 89 |
| in..... | 314 | at..... | 173 | it..... | 111 | ma..... | 88 |
| an..... | 312 | or..... | 153 | al..... | 110 | co..... | 85 |
| of..... | 295 | es..... | 128 | he..... | 94 | be..... | 77 |
| re..... | 232 | se..... | 121 | ha..... | 93 | le..... | 77 |
| er..... | 227 | ed..... | 120 | ve..... | 92 | pr..... | 72 |
| on..... | 226 | to..... | 120 | de..... | 91 | la..... | 71 |
| en..... | 186 | ar..... | 117 | ou..... | 90 | il..... | 70 |

This, of course, does not answer the questions asked, but the material furnished may be of some assistance to the inquirer, should he wish to pursue the subject further.

It may be added, that, in the number of words mentioned, the word *the* occurred 250 times; *of*, 180 times; *and*, 144 times; *to*, 79 times; and *in*, 74 times.



The Flower-Heller Metallic Tie.

918 words occurred only once each, 163 twice, and 65 three times. The three-letter combination *the* (in *there, them*, etc., as well as alone) occurred 400 times; *and*, 172 times; *ing*, 114 times.

A very suggestive point to type-writer manufacturers and inventors is the fact that in all these words the letter *z* occurred but 8 times, while *th* occurred 605 times, and *the*, 400 times.

## The Flower-Heller Metallic Railway Tie.

One of the latest efforts in the shape of a compromise between wooden and metallic railway ties is here shown. The tie proper is a metal shell, into the ends of which two blocks of wood are inserted, and on these blocks the rails directly rest, and to them the rails are spiked. The inventors make out a good case in the decreased amount of wood required, as compared with an ordinary tie, and in the entire absence of bolts, rivets, screws, clamps or keys, as compared with the usual metallic railway tie.

The shoulders in this tie firmly grip the ballast and prevent all endwise movement, and this feature should make it especially useful on curves with considerable elevation of outer rail. The general claims made for this tie are, that it preserves the wood cushion under the rail, and permits spiking as is now done; the slots in the metal shell hold the rails to an exact gauge and thus reduce the oscillation of fast-running trains; and, finally, the form is such that the rail can be given a new bearing by merely drawing the spikes and turning the block over without disturbing the solidly tamped ballast.

The first cost of this tie is not stated, but is of course considerably more than that of an ordinary wooden tie at present. But the inventors point out, very properly, that this first cost is not the only consideration, for if the life of an ordinary wooden tie is 6 years, and the metal shell will last six times as long, the renewal with this tie is simply the renewal at long periods of the wood blocks, as compared with the disturbance of ballast and remaking of the roadbed once in 6 years. The owners of the patent are represented by the American Metallic Railway Tie Co., of 230 South Fourth St., Philadelphia, Pa.

THE INDIANA COMMISSION for the removal of the limestone ledge in the Kankakee river, near Momence, Ill., it is said, are meeting with oppositon from the Chicago & Eastern Illinois Railway Co. The purpose of the removal is to drain about 1,000,000 acres of Indiana swamp land. The Railway Co. claims that their property will in some way be damaged $30,000 if the ledge is removed, and refuses right of way under its bridge, until the State agrees to pay damages.

## Floods Through the Failure of Natural Barriers.

At this time, when the attention of the public has been so forcibly called to the danger that may be caused by bodies of water stored by artificial embankments, and when the possibilities of any existing or proposed reservoir breaking away are being carefully canvassed, it seems well to call attention to the fact that floods are possible and have actually occurred by the giving way of natural barriers.

That this is theoretically possible, any one familiar with the geological formation of the drift strata and of the mode of formation of most of our numerous lakes and ponds lying north of the parallel of 40° will admit. The mass of material which during the drift period was carried here and there under the influences of glacial and hydraulic action was left at its close in all sorts of peculiar arrangements by the great floods which are generally believed to have taken place as the ice mass melted. Layers of quicksand, gravel, clay, hardpan, and other materials were deposited wherever the velocity of the carrying current dictated, and, with the remains of the great moraines left by the glaciers, they now form the "outcrop" all over the northern part of the continent where not changed by later geologic action. In the hollows scooped out by the glaciers of the drift period the water collected at its close, forming very numerous lakes. In a great many cases these lakes have worn down their outlets; and, either suddenly or gradually, their waters have passed out, leaving their former bed dry land. A large part of the mountainous region of northern Vermont was once covered with lakes many times the size of any now existing there, according to the testimony of the best geologists, and doubtless similar formations are found in other sections.

How the natural barrier of a lake might give way suddenly, it is easy to conceive. Suppose the barrier over which its outlet passes to be composed of some material stable at ordinary velocities of the water. Then suppose an unusually heavy rainfall to occur, like that which caused the disaster on the Conemaugh, sufficient to increase the velocity of flow in the outlet to a point at which the material over which the outlet passes begins to be eroded. If, now, the outlet has a considerable fall soon after it leaves the lake, so that the eroded material is not deposited to check the flow (a not uncommon condition at the mouth of mountain lakes), it is plain that the emptying of the lake is likely to take place. The outlet constantly deepens, permitting the escape of a larger body of water, which moves with continually increasing velocity and cuts faster into the bed of the outlet, thus hastening the work of destruction.

Of course, to render such an occurrence possible, several necessary conditions must be combined; and almost certainly the places are extremely few where such a combination exists. Nevertheless, the combination is at least possible; and, as we shall now show, has caused at least two floods to take place.

There are in the northern part of the State of Vermont three water-sheds, one sloping to the west toward Lake Champlain; one to the north toward Memphremagog lake, the source of the St. Francis river in the Province of Quebec; and the third easterly, toward the Connecticut river. Long pond (or lake), which was emptied of its waters in the early part of this century, as described in the following extract from THOMPSON'S "Vermont," was located at the summit of the water-shed, so that while its outlet was on the south, its northern shore was so low that it was possible by a few hours' work to open a channel there toward the north.

Long pond, now better known as Runaway pond, was situated partly in Glover and partly in Greensboro. It was 1¼ miles long and ¼ mile wide, and discharged its waters to the south, forming one of the head branches of the river Lamoille. [Which runs westward to Lake Champlain.—ED.] On June 6, 1810, about 60 persons went to the pond to open an outlet to the north into the Barton river, that the mills on that stream might receive from it an occasional supply of water. A small channel was excavated, and the water commenced running in a northerly direction. It happened that the northern barrier of the pond consisted entirely of quicksand, except an encrusting of clay next the water. The sand was immediately removed by the current, and a large channel formed. The basin formed by the encrusting of clay was incapable of sustaining the incumbent mass of waters, and it broke. The whole pond immediately took a northerly course, and in 15 minutes from this time its bed was left entirely bare. It was discharged so suddenly that the country below was instantly inundated. The deluge advanced like a wall of waters 60 or 70 ft. in height, and 20 rods in width, leveling the forests and the hills, filling up the valleys, and sweeping off mills, houses, barns, fences, cattle, horses, and sheep as it passed, for a distance of more than 10 miles, barely giving the inhabitants sufficient notice of its approach to permit them to escape to the mountains. A rock, supposed to weigh more than 100 tons, was removed half a mile from its bed. The waters moved so rapidly as to reach Memphremagog lake, distant 27 miles, in about 6 hours from the time they left the pond. Nothing now remains of the pond but its bed, part of which is cultivated and a part overgrown with trees, bushes, and wild grass, with a small brook running through it, which is now the head branch of the Barton river. The channel through which the waters escaped is 127 ft. in depth and several rods in width.

From the above account it would seem that the giving way of the barrier must have been precisely similar to the course of events at the South Fork dam, the clay stratum, like the inner half of the South Fork dam, standing until the washing away of the material behind it left it unable to sustain the pressure of the water. The suddenness of the break seems to have been even greater than at the South Fork dam, if the statement that 15 minutes was sufficient to empty the lake a mile and a half in length, is to be relied upon. The depth of the break was considerably greater than that in the South Fork dam, the area of water in the pond was at least equal to that which was stored there, and the volume of water was probably considerably greater

At the time this disaster occurred the State was still in its pioneer days, and the river bottoms over which the flood swept, were probably but thinly settled, which helps to account for the fact that no loss of life occurred. According to our best information, the valley of the Barton river, down which the flood passed, is quite broad, and the river has but a moderate fall for most of the distance to the lake, which accounts for the length of time taken by the flood to reach there.

Another breakaway, of which, however, only meagre data have been preserved, occurred a few years after the one just described on North pond, lying in the mountains about 30 miles west of the pond just described, in the town of Eden. The pond is about 2 miles long and ¼ mile broad and is of very considerable depth. It is the source of a tributary of the Lamoille river. We have no information as to whether the outlet was still in its natural state, or whether it had been closed up and provided with a gate for regulating the flow to mills below, though, as the country was still so new, the latter supposition seems improbable. It is not certain either that the natural barrier which ran across the valley of the outlet may not have been raised higher by the settlers, though that seems still more improbable. The only facts positively known to us at present are that the natural barrier gave way with such suddenness that a man on horseback was sent to warn the settlers below that bridges and buildings all along the course of the torrent were carried away, and that the flood was great enough to alarm those in the valley ten miles below by its roar some time before it came in sight.

In this case, however, the whole pond was not drained. The natural barrier was cut down to the bed rock and the surface of the pond was lowered probably from 10 to 20 ft. An artificial barrier was afterward built in the place of the natural one formerly existing, and is still standing.

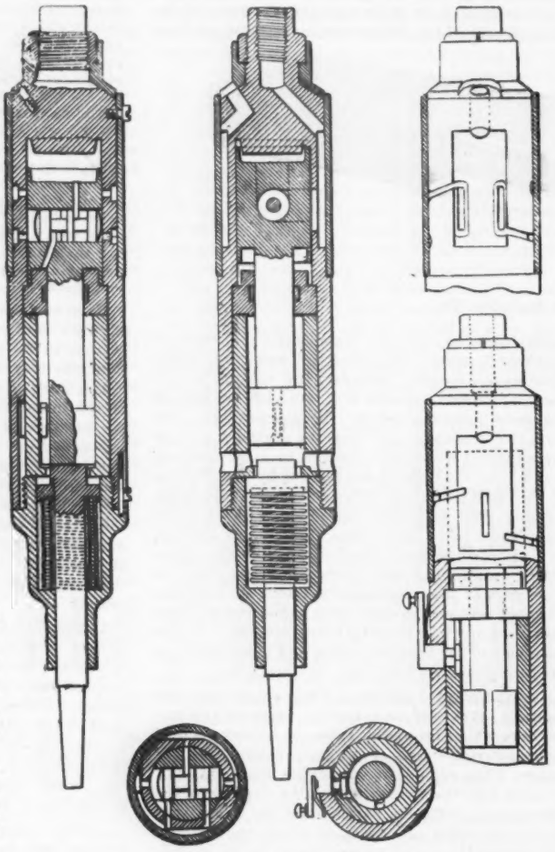
It is a curious evidence of the influence of these two floods, although they occurred three-quarters of

a century ago, that whenever a season of very heavy rains occur in northern Vermont, the people along the valley of the Lamoille river discuss the chances that other ponds on the headwaters of that stream may burst their barriers and send down a flood to the valley below.

### The MacCoy Pneumatic Tool.

Our illustration shows a remarkably simple and effective tool, operated by compressed air or steam, and applicable to a variety of useful purposes. It is practically an automatic hammer, delivering a rapid succession of blows (estimated as high as 15,000 strokes per minute), and it carries a tool holder into which can be inserted suitable bits or chisels for cutting wood, metal, or stone, a tool for caulking the seams of boilers, or tools for chasing silver ware or making *repoussé* work in metal.

Briefly described, the outside appearance is that of a short cylinder, with the tube connection for air or steam at one end and a tool-holder projecting from the other end. Inside of this shell is a working cylinder, with grooves on its outer surface and passages leading from the air-supply tube to a slotted chamber in the outside of the working cylinder, and terminating in inlet ports leading to the inside of the inner cylinder. Another slotted chamber in the external surface of the working cylinder leads from the reduction ports through the cylinder to a channel leading to the open air, through the head of the cylinder. The piston is long and fluid-tight. In this piston is a piston-valve working transversely under the pressure of steam or air at 40 lbs. per sq. inch, in very much the same manner as the piston valves of some steam pumps. This valve is a cylindrical plug having two grooves formed in it with a collar between. It fits in a seat in the piston, and covers and uncovers admission and exhaust ports leading to the ends of the working cylinder. The piston itself is not connected with the tool-holder, but acts as a hammer; a spiral spring surrounding the tool-holder serves to draw back the latter. As the piston rises and falls in the cylinder, it closes the ports and inclosures enough of air between it and the ends of the cylinder to form an elastic cushion and relieve the tool of shock. The thin film of air always surrounding the piston seems also to prevent any appreciable wear in spite of the rapid motion.



The MacCoy Pneumatic Tool.

We have lately seen this tool at work in the establishment of the Messrs. BROADBENT, at Broad and Chestnut Sts., Philadelphia, and can therefore speak of the really wonderful action of this tool on stone and iron. Applied to marble, the most delicate carving—too delicate for ordinary mallet and chisel work—was done by this tool with a smoothness of surface and a perfection of cutting only surpassed by the celerity with which the work was accomplished. It is really a planing and not a cutting action; for, as the inventor says with truth, the blows are so rapid that there is no time between them for the tool to rebound or quit contact with the material, and as each stroke does its work, and thus expends mechanical energy, the tendency or ability to rebound has departed with this spent energy.

A modification of the same machine hammers out *repoussé* work with a speed and finish that must have a commercial effect on this branch of the arts; and as applied to caulking steam boilers, the resulting seam was apparently perfect in efficiency and certainly so in finished appearance.

This tool is the invention of Mr. JAMES MACCOY, and a late report of the Committee on Science and Arts of the Franklin Institute states that it is "deserving of the highest recognition as a valuable improvement," and the committee further recommend that it be awarded the John Scott Legacy premium and medal. We are indebted to this report for the illustration used.

### Tests of a Westinghouse Engine.*

For many years the author has given considerable attention to high-speed single-acting engines of the Westinghouse type, and has made several tests with these engines: these all go to prove that great economy can be attained in the consumption of steam if careful attention is paid to details in their design and construction. One of the most difficult sources of waste to overcome is that due to long ports and clearances at the ends of the stroke. The great speed at which these engines run makes this detail of design the more important, as this waste is multiplied by the number of revolutions.

The advantages of high-speed engines of comparatively short strokes and high numbers of revolutions, were due to the fact that the temperature of the walls of the cylinders, in short-stroke high-speed engines, is subject to much less possibility of variation than in engines of long stroke and comparatively few revolutions. If the cylinders are properly covered with good non-conducting material, the loss by radiation is very small indeed.

TABLE OF TESTS OF A WESTINGHOUSE ENGINE, 14 INS. AND 24 BY 14 INS. COMPOUND.

*Water Rates per Brake H. P. at varying Pressures and Loads.*

| Condensing. | | | | | Non-Condensing | | | | |
|---|---|---|---|---|---|---|---|---|---|
| H. P. Brake | Boiler Pressure. | | | | H. P. Brake | Boiler Pressure. | | | |
| | 120 | 100 | 80 | 60 | | 120 | 100 | 80 | 60 |
| 200 | 19.62 | 22.53 | | | 200 | 23.94 | | | |
| 160 | 18.86 | 20.02 | 23.17 | | 160 | 25.50 | 25.20 | | |
| 130 | 18.38 | 19.56 | 21.32 | 24.30 | 130 | 24.32 | 26.24 | 27.70 | |
| 100 | 19.14 | 19.44 | 20.34 | 23.10 | 100 | 25.57 | 27.75 | 29.80 | |
| 70 | 19.80 | 20.05 | 21.43 | 22.57 | 90 | 26.51 | 28.30 | 29.80 | 31.70 |
| 40 | 22.90 | 23.12 | 24.75 | 25.25 | 70 | 29.40 | 30.77 | 32.48 | 36.00 |
| | | | | | 40 | 40 05 | 39.30 | 42 75 | 45.82 |

Unjacketed and uncorrected by calorimeter.

* By Stephen Alley, from selected papers of the Institution of Civil Engineers.

The accompanying table gives a series of tests made in February, 1888, at Pittsburg, U. S. A., with a Westinghouse compound engine.

The amount of water consumed was arrived at by a surface condenser, so constructed that it condensed all the steam from the engine, and discharged it into a tank, in which it was measured and weighed. Mr. Westinghouse rated the consumption of water on the brake H. P., or the power developed after deducting the friction of the moving parts of the engine. While working on a condenser the consumption, when using 120 lbs. of steam was on a prolonged trial 19.62 lbs. per brake H. P., and when exhausting into the atmosphere, 23.9 lbs.

The table gives the consumption of water and power developed with the engine working at pressures varying from 60 lbs. to 120 lbs. per square inch.

BRIDGE PAINTERS on the New York, Lake Erie & Western railway have taken the usual dark red for all parts of the bridge except the tension diagonals, which are painted dark green.

## PERSONAL.

Pres. GAZZAM, of the Chautauqua Lake Railway, has resigned, and Mr. A. O. GEORGER, of Philadelphia, has been elected his successor. Mr. D. H. BURT, of Boston, has been elected a Director.

Mr. JAMES BEGGS, consulting mechanical engineer, of Trenton, N. J., committed suicide July 19.

Mr. HORACE A. TAYLOR, of Wisconsin, has been appointed by the President as Commissioner of Railways, succeeding Gen. JOSEPH E. JOHNSTON.

Mr. C. A. WILSON is Chief Engineer, and Mr. W. R. WOODFORD General Superintendent, of the Wheeling & Lake Erie Ry.

Col. JOSEPH C. TIFFANY, who was Superintendent of Construction of the Second Ave. elevated road in New York, under J. B. & J. M. Cornell; and who was late Superintendent of Construction of the Deming, Sierra Madre & Pacific Ry., died recently at Deming, N. M.

MR. EDWIN A. HILL has been appointed Real Estate Agent of the Cairo, Vincennes & Chicago Ry. Co., in charge of all its real estate and all matters pertaining to taxation, with office at Cincinnati, O.

Mr. JOHN A. FULTON, Bridge Engineer of the Toledo, St. Louis & Kansas City road, has resigned to accept a similar position with the Chief Engineer's department of the Lake Shore & Michigan Southern, at Cleveland, O.

Mr. A. BECKERT, for many years Master Mechanic in the Baltimore & Ohio shops at Mt. Clare, and formerly at Sandusky, O. has been appointed General Master Mechanic of the Alabama division of the Louisville & Nashville, at Decatur, Ala.

Division Roadmaster ADAMS, of the Wabash, has been appointed General Roadmaster of the Wabash east of the river. Mr. PATRICK WARD, formerly Roadmaster on the Cairo & Vincennes, succeeds Mr. ADAMS on the Huntington Division.

Mr. GEORGE S. MORISON, Civil Engineer, has removed his Chicago office from 205 La Salle St. to The Rookery, Room 1120. His New York office remains at 35 Wall St., as heretofore.

Mr. R. W. HILDRETH and Mr. W. A. NETTLETON, of 10 Cedar St., New York, have terminated the co-partnership existing under the firm name of Hildreth & Nettleton. The business will be continued by Mr. R. W. HILDRETH, under the firm name of R. W. Hildreth & Co.

Mr. D. W. RIDER, late private secretary to Receiver MCNULTA, of the Wabash Railway, has been appointed Superintendent of the Jacksonville Southeastern line, comprising the Chicago, Peoria & St. Louis, Louisville & St. Louis, and Litchfield, Carrollton & Western roads, over 300 miles of road.

Col. H. T. DOUGLAS, the present Chief Engineer of the Philadelphia line of the B. & O., has been made Chief Engineer of the entire Baltimore & Ohio system. Mr. ALFRED WALTER, who has filled a number of important positions in the service of the Pennsylvania and the Northern Central Railway companies, has been appointed General Superintendent of the two divisions east of the Ohio river. Under the new plan there is a general manager for the entire system, which is divided into three general divisions—the one west of the Ohio river to be known as the Trans-Ohio Division; the one east of the Ohio, as far as Mount Clare, the Main Line Division; and the Eastern Division, including the line from Washington to Philadelphia, and all the New York terminals and properties.

There will be a general superintendent in each division, assisted by division superintendents, general superintendent of motive power, engineers of maintenance of way, and superintendent of car service.

Mr. E. G. THOMPSON, Superintendent of the St. Louis Bridge & Tunnel Co., died recently.

Hon. FRANK M. BROWN, of Denver, Col., late President of the proposed Denver, Colorado Cañon & Pacific Railroad, was drowned in the Marble Cañon, on the Colorado river on July 10. Mr. ROBERT S. STANTON, Chief Engineer, telegraphs us from Kanab, Utah, that Mr. BROWN'S boat capsized while running a rapid, he was thrown into a whirlpool and was unable to extricate himself, while his companion got into the main current and landed about 600 ft. below the scene of the accident. All the other boats in the expedition passed safely. Mr. STANTON also says that on July 15, another boat was driven against the cliff and was capsized by the boatmen in pushing it off; by this accident boatmen P. M. HANSBROUGH and H. C. RICHARDS lost their lives. It is impossible to recover any of the bodies

## BOOK REVIEWS.

*Fourth Biennial Report of the State Engineer to the Governor of Colorado for the years 1887 and 1888.* Part I. Second Edition. Paper, 6 x 10 ins. 424 pp.

The report of State Engineer J. S. GREENE for the two years ending Nov. 30, 1888, relates wholly to irrigation in Colorado. The bulk of the volume consists of reports from the various commissioners in charge of the 40 and more irrigation districts into which the State is divided. In addition, there are extracts from the Colorado laws on irrigation, and from court decisions regarding priority of water claims. There are also some notes on the measurements of the flow of streams, the duty of water for irrigation, and also on storage reservoirs, and needed irrigation laws.

In his preface Mr. GREENE gives the following interesting figures, which are approximate, regarding the sections of the State east and west of the continental divide.

WEST OF THE CONTINENTAL DIVIDE.

| | |
|---|---|
| Area of mountain lands | 16,360,000 acres. |
| Mean annual precipitation, | 33 ins |
| Area of plateaus, rolling and valley lands, | 9,400,000 acres. |
| Mean annual precipitation, | 10.70 ins. |
| Total area, | 25,760 acres. |
| Mean annual precipitation, whole area, | 25 ins. |

EAST OF THE CONTINENTAL DIVIDE.

| | |
|---|---|
| Area of mountain lands, | 1,0200,000 acres. |
| Area annual precipitation, | 30 ins. |
| Area of plains, rolling and valley lands, | 30,600,000 acres. |
| Mean annual precipitation, | 15 ins. |
| Total area, | 40,800,000 acres. |
| Mean annual precipitation, whole area, | 18.7 ins. |

It will be seen that the precipitation on the mountain lands is largest at the west of the divide, and on the remaining lands at the east of the divide; that at the west the precipitation on the mountain lands is over three times, and at the east, over twice that on the lower lands; and that the average for the whole area of each section is 6.3 ins. greater on the western side. This last is largely accounted for by the far greater area of low lands at the east.

Of the total State area of 66,560,000 acres, less than 5 per cent., it is said, is without vegetation, and more than one-half is reported as needing only water to make it good arable land. Of the total area requiring irrigation about 2,000,000 acres have been watered by some 4,000 miles of ditches.

The limit of remunerative farming, without irrigation, is reached when the annual precipitation falls below 22 ins. According to measurements, the quantity of water passing through the cañon of the Cache la Poudre river in 1884 was equivalent to a precipitation of 13.4 ins. over the entire drainage area of the river above the cañon. The precipitation for that district in 1884 was estimated at 33.4 ins., about 40 per cent. of which could have been saved for irrigation, if the means had been provided. This last amount, with the rainfall available for the same purpose, would have given a mean annual depth of about 27 i s. of water over 10,200,000 acres of plains and valley lands. But in this connection it should be borne in mind that a considerable percentage of this amount would have been lost in distribution, and that the surface of the whole district is such that an even distribution would have been impossible. In 1887 the total area irrigated in this district was but 108,985 acres, through 341 miles of ditches.

The area in Colorado under irrigation is divided into five water divisions, known respectively as the South Platte, Arkansas, Rio Grange, San Juan, and Grand, or as divisions Nos. 1 to 5. Over each division there is a superintendent, and the divisions are subdivided into districts, which are in the immediate charge of commissioners. The duties of the superintendents and commissioners are to see that the irrigation laws are respected, and that an equitable division of water is made to the various ditches from the sources of supply.

The reports of the commissioners have been put in tabular form, and give the names and lengths of the various ditches, together with the number of acres of afalfa, seeded grasses other than afalfa, natural grasses, and other crops irrigated by each. They also give the stream from which water is taken, date of appropriation, cubic feet of water appropriated, and total cubic feet of water appropriated prior to each new appropriation. Further details are sometimes given, including some details regarding the storage above.

For some of the districts tabular statements are given regarding artesian wells within their limits.

Altogether the report shows that considerable progress was made in Colorado during the two years under consideration, in the matter of systematizing the supervision of irrigation work and in collecting valuable statistics. It is hoped that the work will be carried forward in the same spirit, as there is far too little data available on this subject, and it seems to be the especial province of the States more immediately concerned to collect and compile information regarding existing irrigation works, while the general Government gives its assistance in the surveys and development of new regions.

**Elements of Weather in the United States of most interest to Engineers, for the month of June, 1889.**

| STATIONS. | Temperature. Degrees Fah. | | | | Wind velocity. Miles per hour. | | | Precipitation. Rain and melted snow. Inches. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average | Max. | Min. | Range. | Average. | Max. | Direction at time of Max. Vel. | Total. | Heaviest in 24 hours. | No. rainy days |
| **Northern Cities.** | | | | | | | | | | |
| Northfield, Vt | 63.4 | 86 | 34 | 51 | 7.5 | 40 | NW | 5.02 | 0.85 | 19 |
| Portland, Me | 63.6 | 84 | 46 | 38 | 8.0 | 30 | S | 3.28 | 1.35 | 12 |
| New York City | 68.8 | 88 | 53 | 35 | 8.1 | 36 | SE | 2.38 | 0.74 | 09 |
| Pittsburg, Pa | 67.3 | 87 | 46 | 41 | 5.6 | 24 | SW | 4.93 | 1.75 | 18 |
| Chicago, Ill | 61.2 | 86 | 42 | 44 | 7.8 | 28 | NW | 2.93 | 0.68 | 12 |
| Omaha, Neb | 68.7 | 96 | 44 | 46 | 6.9 | 32 | N | 5.44 | 2.02 | 08 |
| St. Paul, Minn | 64.0 | 90 | 42 | 48 | 6.1 | 23 | NW | 1.61 | 0.63 | 06 |
| Duluth, Minn | 57.8 | 80 | 43 | 37 | 5.8 | 23 | NE | 1.85 | 0.67 | 07 |
| Bismarck, Dak | 65.6 | 97 | 42 | 55 | 8.6 | 46 | S | 1.03 | 0.39 | 11 |
| Average | 64.5 | 87.4 | 43.6 | 43.8 | 7.2 | 31.3 | | 3.16 | 1.01 | 11.3 |
| **Southern Cities.** | | | | | | | | | | |
| Washington City | 69.8 | 90 | 48 | 42 | 5.8 | 25 | NW | 5.01 | 1.09 | 17 |
| Louisville, Ky | 66.9 | 93 | 44 | 49 | 4.6 | 26 | SW | 5.76 | 1.38 | 19 |
| St. Louis, Mo | 69.6 | 93 | 47 | 46 | 7.5 | 44 | W | 4.72 | 1.13 | 13 |
| Savannah, Ga | 75.0 | 96 | 50 | 46 | 7.2 | 32 | N | 9.73 | 3.10 | 14 |
| Leavenworth, Kan | 69.9 | 91 | 49 | 42 | 5.2 | 28 | S | 3.01 | 1.02 | 8 |
| Jacksonville, Fla | 76.2 | 95 | 54 | 41 | 7.1 | 28 | SE | 6.89 | 1.69 | 13 |
| Chattanooga, Tenn | 70.3 | 87 | 39 | 48 | 3.9 | 36 | NW | 4.16 | 1.16 | 19 |
| New Orleans, La | 75.8 | 92 | 58 | 34 | 7.0 | 24 | N | 7.02 | 2.86 | 14 |
| Memphis, Tenn | 73.0 | 92 | 50 | 42 | 6.0 | 33 | SW | 7.39 | 4.12 | 15 |
| Palestine, Tex | 75.2 | 91 | 55 | 36 | 4.6 | 32 | W | 7.00 | 1.94 | 14 |
| Average | 72.2 | 92.0 | 49.4 | 42.6 | 5.9 | 30.8 | | 6.13 | 1.95 | 14.4 |
| **Western Cities.** | | | | | | | | | | |
| Helena, Mont | 63.3 | 89 | 40 | 49 | 5.0 | 34 | NE | 0.40 | 0.28 | 4 |
| Port Angeles, Wash | 53.6 | 74 | 37 | 37 | self-register out of order | | | 0.94 | 0.54 | 6 |
| San Francisco, Cal | 58.1 | 75 | 52 | 23 | 10.9 | 32 | SW | 0.06 | 0.03 | 1 |
| Salt Lake City, Utah | 71.0 | 97 | 47 | 50 | 6.1 | 42 | W | 0.01 | 0.01 | 1 |
| Denver, Col | 62.4 | 92 | 37 | 55 | 5.3 | 34 | N | 1.88 | 0.99 | 12 |
| Yuma, Ariz | 85.9 | 109 | 63 | 46 | 6.3 | 24 | SW | T | T | 0 |
| Santa Fé, N. Mex | 64.6 | 86 | 61 | 25 | 7.4 | 48 | N | 0.63 | 0.19 | 13 |
| Average | 65.5 | 88.9 | 48.1 | 40.7 | 6.8 | 35.7 | | 0.56 | 0.29 | 5.3 |

## PUBLICATIONS RECEIVED.

—*Fourth Biennial Report of the State Engineer to the Governor of Colorado for the years 1887 and 1888.* Part I. Second edition. Paper, 6x9 ins. 424 pp. Published by the State.

This report of State Engineer J. S. GREENE covers the two fiscal years ending Nov. 30, 1888, and relates wholly to irrigation. Further notice is given elsewhere.

—*Prospectus of the Hale Pavement Co.* Issued by the company, at Staunton, Va.

This pamphlet describes the Hale patent brick pavement, which consists of a layer of hard-burned bricks laid upon a bed of sand, underneath which is a plank floor and another bed of sand. Results of tests of the brick are given, and testimonials as to the efficiency of the pavement.

—*Proceedings of the Institution of Civil Engineers*, London, England.

The latest papers received are as follows: "Indian Railways," by F. J. WARING: 45 pp., with 45 pp. of discussion; the paper deals with the construction, cost, and present condition of the railway system. "Alternate-Current Machinery," by GILBERT KAPP; 44 pp. with 62 pp. of discussion. "Steamers for Winter Navigation and Ice Breaking," by R. RUNCHVEY; 27 pp; this paper gives the mathematical principles and details of construction of such vessels, with illustrations of existing and proposed steamers for this service. "Stress Diagrams of Solid Structures," by R. H. SMITH; 19 pp. "The Tides in the Neighborhood of Portsmouth (England)," by B. O. TOWNSHEND; 6 pp.

—*Photographs of the Washington Bridge.*—The Jackson Architectural Iron Works, 315 E. 28th St., New York, have issued a handsome card of photographs of this new bridge over the Harlem river. The ornamental iron and bronze work for this structure was executed at the Jackson Works.

—*Notes on the Theory of Cantilever Bridges.*—By CHARLES MCMILLAN, C. E., Prof. of Civil Engineering at Princeton College.

A pamphlet of 20 pp, with concise notes and formulæ on the various types of cantilever bridges. These variations and the effect of load and reaction and the determination of stresses are clearly expressed.

*Tables of Squares*, containing the square of every foot, inch, and sixteenth of an inch between one sixteenth of an inch and fifty feet. For Engineers and Calculators. By E. E. BUCHANAN, C. E. Price, $2.00.

A handy book for calculators and in bridge building offices. Here is an example: To find the square of $12' 6\frac{5}{16}''$: From the tables, the square of $12' 6\frac{5}{16}'' = 156.64024336$ and of $12' 6\frac{4}{16}'' = 156.51010816$

The difference = .13013520
one half of which = .06506760

## SOCIETY PROCEEDINGS.

**Denver Society of Civil Engineers and Architects.**—At the regular meeting on July 9, Mr. EDMUND P. MARTIN gave a description of the 14th St. viaduct of Denver. The viaduct will extend from Holliday St. along the south bank of Cherry creek over the Platte river to Platte St. in North Denver, a total length of 3,500 ft. It will cross over most of the railways coming into the city and will have a roadway of 40 ft. between sidewalks, which are 8 ft. wide. It will be built of iron, with earth embankment approaches, and will cost complete $107,000; grade on west approach, 3 per cent. east approach 2.6 per cent. The embankments are built by an endless chain dredger taking sand and gravel from the bed of Cherry creek, and will be protected by smelter slag for 8 ft. in height. Cost of embankment about $30 per lin. ft. Cost of 750 ft. of iron work so far, $4,400. The girders and posts about $40 per ft.

In the discussion about dams, Mr. E. S. NETTLETON, Supervising Engineer U. S. Geological Survey, gave a description of the proposed new dam at El Paso, Tex. across the Rio Grande. This dam, if built, will make the largest fresh-water reservoir in the world, and is to be constructed by the United States and the Republic of Mexico. There are three proposed sites for the dam, which is to be 60 ft. high, and from 450 to 700 ft. long on top. The lake will average 3½ miles wide and 15 miles long and is to be used for manufacturing and irrigating. It will have gates to control floods, a silt reservoir, flusher, etc. The Conemaugh and Quaker Bridge dams were discussed.

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**Drawings for publication** *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*


### Coming Technical Meetings.

**Association of Civil Engineers of Dallas, Tex.**—Regular monthly meeting, August 2 Secy., E. K. Smoot, Elm and Austin Sts.

**National Electric Light Association.**—A convention will be held at Niagara Falls, N. Y., Aug. 6, 7, 8. Secy., A. V. Garratt, 18 Cortlandt St., New York City.

**New England Roadmasters' Association.**—Annual meeting at Boston, Aug. 21. Secy., W. F. Bill, Woonsocket, R. I.

**Civil Engineers' Society of St. Paul, Minn.**—Next meeting, Sept. 2. Secy., Geo. L. Wilson, City Hall.

**Roadmasters' Association of America.**—The annual convention will be held at Denver, Col., beginning Sept. 10. Secy., H. W. Reed, Waycross Ga.

**Boston Society of Civil Engineers.**—Next meeting, Sept. 18. Secy., S. E. Tinkham, City Hall.

IN Mr. LINDENTHAL'S "Reply to Certain Criticisms, etc.," in our last issue, a slight typographical error occurs in Mr. L's statement of weights in the original design for his bridge; 18,000 tons should read 18,700 tons. The total as given is correct.

WE regret exceedingly to note elsewhere in this issue the unexpected death of Mr. F. M. BROWN, late president of the Denver, Colorado Cañon & Pacific Railroad. Mr. BROWN was recently in this office, filled with enthusiasm over his project for building a new outlet to the Pacific coast through the great Colorado cañon. Unlike the average promoter or president of a railway, he had all the courage of his convictions, and accompanied his engineers upon what he already knew, from previous experience, was an adventurous, difficult, and possibly a dangerous survey. He was young, only 42 years of age, and the type of an energetic man of affairs, and the enterprise will doubtless miss his leadership. The Marble cañon, in which he lost his life, lies mainly in the northwest corner of Arizona and has a general width of 6,000 to 8,000 ft., so that it was not one of the narrow and more dangerous parts of this celebrated river course. The telegram to this journal from Chief Engineer STANTON was dated from Kanab, which is a small village lower down, lying under the eaves of the Vermillion cliffs and in the jaws of the Kanab, a lateral cañon occupied by the creek of that name. This village has for some years been the base of operation for all exploration parties working in the Colorado cañon, and is well located for this purpose. Other information than the telegram states that two boats and much of their contents were previously lost, though the journey of 400 miles from Green river, Utah, had been made without loss of life. At the time of the accident the party was reduced to eight men in three boats.

FOUR plans for the new municipal building on City Hall Park in this city are now under examination, we understand, varying widely in cost, type of architecture, etc., but all of them proposing to erect a lofty building on a goodly part of our only downtown park worth calling by that name. The sod has not been broken, and it is not yet too late to reconsider this hasty and improper suggestion of our city authorities, and to erect the proposed building anywhere except on the park, as we have before suggested. The citizens of New York cannot spare a square foot of this ground, for it serves a good purpose now in giving shelter and rest to those who sorely need it, and in refreshing every passerby who gazes upon its green sod and fair trees. But aside from this somewhat negative value, occasion might at any time arise to make it a still more valued possession to the city. In the case of a Chicago or Boston fire, a general conflagration, it is practically the only piece of open ground down town and above Battery Park that could possibly check the flames or be used as a place of refuge for the people and for the temporary storage of valuable goods. And in the case of extensive riots from any cause, it is the one commanding place in which troops could be massed without exposure to a discharge of missiles from housetops. Both of these uses for the park are, we trust, very remote, but they are contingencies that may arise and should be considered when a proposition is before the public to curtail this area. It was not for the mere gratification of citizens or for pure city adornment that Paris to-day stands unapproached in its wide and diverging boulevards, open squares, and shady avenues. They do adorn and attract, and for that reason alone are worth what they cost; but Baron HAUSSEMAN'S well-known purpose in laying out this new Paris and in eliminating narrow and crooked streets, was the protection of the city against civic mobs. Tradition has it that a similar precaution influenced the French civil engineer L'ENFANT in laying out the streets of our own city of Washington; and though they have never been utilized for such a purpose, no one regrets that the narrow, gridiron type of street location followed in the older American cities was there so widely diverged from. New York is one of these older cities, and is handicapped with narrow roadways all about the City Hall; and while it is too late now to undertake the enormously expensive task of widening these streets, it is not too late to prevent any further contraction, such as is proposed by our Mayor. The City Post Office building made the first encroachment of later years upon the old park, located there from motives of mistaken economy. But if this new municipal building is permitted to further decrease an already too small area, the whole of it may disappear in time. This part of our city is a storehouse for goods of all descriptions and of enormous aggregate value; and in the case of a serious fire, the effect of an open strip of park can be estimated in checking the spread of the flames. This one chance is worth many sites for new buildings in other localities, where they will do good instead of harm in replacing present dangerous conditions by better construction.

THE result of the long tour of investigation made by the Senate Committee on the competition of Canadian railways with American lines, has been just what might have been expected. The prominent representatives of every section very naturally asked that the especial interests of that section should be fostered. They believed that the Canadian roads competed with the others for traffic and kept the rates down, thus working for the interests especially of New England and the Northwest; therefore, they asked that the Canadian roads be given every needful facility to compete with the American roads. Even Chicago, which, if we are not mistaken, was the first to start the cry of "American traffic for American railways," hoping thus to shut up the Sault Ste. Marie route, and retain her prestige as the only gateway to the Northwest, has concluded that it will never do to shut out the Grand Trunk, even for the sake of triumphing over St. Paul and Minneapolis. This result of the investigation is not at all surprising. Merchants and the heads of commercial organizations have never been noted for their comprehension of railway problems from any broader standpoint than their own self-interest.

In the examination of railway men, however, the committee elicited some of the most valuable opinions on the railway problem in general which have appeared for some time. The information thus gained ought to be so used as to repay the trouble taken to obtain it.

As regards the Canadian lines, whose competition the committee set out to investigate, no one has as yet expressed any wish to shut them out from participation in American traffic; and while it would be decidedly just and right that they should be brought under the Interstate law, the difficulty in making United States laws effective to regulate commerce in a foreign country seems to be insurmountable. It is probable that the subject will now fall into oblivion, save that the report of the committee's proceedings, printed at the Government printing-office and bound in solemn black covers, will furnish mental nourishment and a political stimulus to bucolic constituents for a generation to come.

IT is absurd to suppose, in the present state of scientific knowledge, that the death of any one person could forever check advance in the production of any article deemed useful to man; and yet this is what the press dispatches are saying concerning the death of a Mr. SEYMOUR, of Findlay, O., and his process for the reduction of aluminium; some going so far as to say that the production of this new metal may now be regarded as a lost art. While aluminium has been but very recently produced in what may be called commercial quantity and at a price that will permit its economical use in the arts, its many valuable qualities, particularly as an alloy with other metals, are too well recognized to allow it to sink out of sight, even had Mr. SEYMOUR alone possessed the art of producing it. But such is not the case. He was only one among many modern chemists and scientific men who were scheming, not to make it—for that has long been possible—but to reduce the cost of manufacture. The Cowles, Castner, Hill, and other processes now produce the metal in quantities and at a price that permit its economical use in many ways; and more than one of these metallurgists confidently point to the not far distant day when aluminium will be as cheap in price as common tin. The base ma-

terial is one of the most abundant on the face of the earth, and the alloys of the metal with copper, iron, and nickel possess qualities that make it more useful for many purposes than any other material now known. As one example, we have seen a metal that was reported to be iron with 10 per cent. of aluminium added; and it was of a silver whiteness, was proof against any but the strongest acids and against all atmospheric influence, and was withal exceedingly strong and very cheap. The uses to which such a metal can be applied are simply without measure.

### The Transit Problem in New York.

The comprehensive transit scheme, elsewhere outlined by a civil engineer correspondent in this issue, has the merit of covering the territory of the city of New York with a complete network of main lines and feeders, and thus well answers the purpose of such a system. The circulating plan is an excellent one for the rapid and uninterrupted handling of trains running at short intervals; in fact, it is the only proper plan under the best conditions of operation, and the surface tracks on certain streets operated with and under the control of the main lines will much better serve the purpose of feeders to the transit system than elevated roads. The island of Manhattan is in great part too narrow to require such an expensive cross-town roadway; and while much less convenient to the short-trip travelers who would use them than a surface track, their existence as elevated roads would be a nuisance difficult to operate and far from ornamental to our city. In the shape of sub surface roads, they would be still less useful as feeders, for the traveler will do his traveling above ground whenever this is possible; and, consequently, the plan outlined of systematizing cross-town surface travel seems the best for the purpose intended.

Tunnel vs. an elevated structure for the main lines is a problem that should properly be left to the careful investigation and estimates of engineering experts. The daylight would doubtless be preferred if the question were left to a popular vote. But as the first cost assumes enormous proportions in considering any comprehensive transit scheme, it is only business-like and proper to weigh all possible plans, and adopt that one which at the least expenditure promises the fullest measure of relief. We heartily approve of the block-plan in laying down the main lines, and as this means a very heavy investment in real estate, the tunnel project would doubtless yield the best returns in rentals, and the most permanent road-bed and consequently a minimum of repairs. But if it is to be a tunnel, it would then seem best to sink the tracks entirely beyond surface influence or real estate and street line considerations, as has been already proposed. We believe a "low-level" tunnel is feasible from an engineering point of view, and even the layman needs not be told of the many sub-surface difficulties, in the construction and the preservation of structures, that would thus be avoided. Rapid elevators of great capacity will solve the station difficulty, and electric light and electrical or compressed air motors will practically settle the question of comfort and ventilation. As to the latter points, we see little difference whether the tunnel is 30 ft. or 150 ft. below the surface: it is as easy to ventilate and light the one as it is the other.

But these are all questions for the commission, which should first be appointed to carefully and intelligently weigh every element or alternative entering into a scheme of such vast dimensions. The material of this commission is of prime and vital importance. It is the common practice to refer questions of public improvement to a body of men successful in financial and commercial pursuits, with the very generally accepted idea that the possession of wealth implies necessarily the possession also of wisdom. These men may be good citizens and wise in the conduct of their own business. But engineering is not their business; and their expressions of opinion upon matters requiring previous training and technical knowledge are absolutely worthless, as much so as if these opinions related to an intricate question of chemical analysis or of astronomical research. The chief reason that this subject of city transit is in its present confused state is that prominent business men, who have taken an interest in it, have belittled the value of engineering science and have engaged in plan-making themselves, without really knowing what they wanted or how best to secure the desired end. The public has been made to believe that the whole matter has been sifted to the bottom and that nothing more can be done; whereas, the fact is that the problem has never had official expert treatment at all.

Most of the transit plans laid before the public are too vague to permit intelligent criticism; the termini of the proposed road are not always laid down; the territory to be served is generally undefined; the kind and class of road are not mentioned, and it is impossible to discover why, in some of these plans, one portion of the territory is well supplied with transit facilities to the utter neglect of other portions equally in want of such facilities. It is patch-work,—just such work as might be expected from a well-intending but technically ignorant promoter of "rapid transit projects." Questions of alternative methods, of operation, speed, and the thousand and one other elements that enter into the problem are neglected by them as unimportant from the standpoint of "a practical business man." As an example of non-expert treatment of technical questions, we have the *rapid* transit plan of 1875, in which a commission of very respectable gentlemen fixed upon *eleven miles per hour* as the maximum speed permissible.

Every good citizen, successful in life and well esteemed by the public, deems himself a proper and fitting candidate for a position on such a commission as we refer to, and the public thinks with him. And yet this same citizen would not attempt to physic his family, plan his house, or mend his own boots. He leaves all these matters—saving the one of engineering—to those who make each a special study or pursuit. Why he should make this exception, and assume that he is fully competent to discuss and decide upon matters of the highest engineering importance, is a conundrum we cannot solve. We only know that it is unhappily a too common assumption.

Public interest demands that the whole technical question of city transit—and it is almost purely technical—should be referred to a board of, say, three distinguished engineers; not affiliated with any present or past rapid transit scheme, but having an expert knowledge of problems in transportation, excavation, masonry, framed structures, and the general detail of railway work. These men should devise the plan in all its detail; and when this is completed then will be the time for the merchants, the bankers, and the solid men to take hold of the matter, draw up the needed legislative bills, press their passage, and finally put the scheme upon a firm financial basis.

To put the proposition into a practical shape, we would suggest that the Mayor of the city appoint the experts, but that he be restricted in his choice to any three men out of a list nominated by the American Society of Civil Engineers. If the Mayor has no appropriation to draw upon for necessary expenses, it is possible that the Stock Exchange, or some other public body of this nature, might be willing to spend a little money in rendering the city a service. But the best plan of all, saving in the delay, would be to obtain legislative sanction and an appropriation of, say, $50,000. The experts should be provided for, and the method of their appointment fixed so as to command only the best men; these experts should consider every plan presented to them and make their own investigations besides, and should finally, with the proper legal assistance, report a bill providing for all the city transit needed. The subject is one important enough to demand a special session of the Legislature. Time is pressing, and the problem is one we cannot too soon be at work upon.

### The Origin of the Gunter's Chain.

THE query by our correspondent of last week regarding the substitution of a chain of 100 ft. for the older Gunter's chain of 66 ft. has opened up a question of interest to engineers, and one about which some curious matter can be gleaned by those who will take the trouble to look it up, as is evident in the communication of Mr. GOODRIDGE, published in this issue. The present generation of civil engineers found the 100-ft. chain in use when they commenced their practice, and few have questioned its source or date of application. But both source and date are interesting to us for the reason that, to the best of our knowledge, its use to-day is confined to American or Canadian engineers, the latter having imported it from the United States. English railway engineers still adhere to the older chain of 66-ft.; and European engineers have adopted the metric standard for all public works, a practice in which they have been followed by the Central and South American nations of Latin origin.

As remarked last week, Col. STEPHEN H. LONG was the first to publish in the United States a work on railway alignment; and the fact that he, in 1829, adapted his table of curves to chords of 100 ft. fixes very nearly at least the date of the introduction into American railway practice of a chain of that length. We know that his book was popular among the earlier engineers in this country, and as the tables were useless without at the same time adopting his standard of chord length, this Railroad Manual must have been largely instrumental in introducing the 100 ft. chain.

Where Col. LONG found the 100-ft. chain is another question. It was not original with him, for Mr. GOODRIDGE shows that it was used in England as long ago as 1780. We would suggest that, as Col. LONG was an American, he only followed out that trait of our national character which led our earlier engineers to cast aside tradition and adapt the new practice of railroad engineering and construction to the conditions surrounding them in a new country. His common sense taught him that there was little or no connection between the acre, as a unit of area, and the alignment of a railway or the computation of earthwork, and there was consequently no good reason for adhering to the ancient standard in the new practice. The 100 ft. chain, as a unit, facilitated calculation in the field and the office; and as it reduced the number of stakes and sights by nearly one-half, it saved valuable time in field work. As these reasons

would be sufficient to deter any American engineer from abandoning present practice for the English method, for example, it is only fair to suppose that a similar line of reasoning by a thoughtful, practical engineer would have induced him to make the original change. Col. LONG entered the Corps of Engineers of the United States army in 1814, was assistant Professor of Mathematics at West Point in 1815, and was in active service in exploration between the Mississippi river and the Rocky Mountains from 1818 until 1826. He had thus abundant practical experience before he published his book in 1829, and we can suppose that his recommendation of a longer unit of length was the result of this experience and a desire to economize in labor and in time. The Manual was published while he was in charge of the surveys for the Baltimore & Ohio railroad, 1827-30.

The 66-ft. chain as a unit of length is of far greater antiquity; it belongs to the acre and its measurements, and to this division of land we must undoubtedly look for its origin, as Mr. GOODRIDGE remarks. While now known as the Gunter's chain, EDMUND GUNTER (1581-1626) only divided it into 100 links of 7.92 ins. each, and by so doing simplified its use, and he possibly introduced metal into its construction, as the better method of using these links. The old measure of 66 ft. was previously divided into four perches or poles of 16½ ft. each. In addition to the proof given in our correspondent's letter, that the 66 ft. standard of length antedated GUNTER, there is a little book in our own library entitled *The Most Profitable and Commendable Science of Surveying, etc. Drawn up and Collected by the Industrie of Valentyne Leigh*, printed in London in 1562. In his directions to the surveyor, our author says that measurements may be made by a "rodde or a lyne," but he prefers the latter, as being "speedier and most commodious, and also of moste antiquitie." He further says, "Your lyne being foure pearches of lengthe, and at every pearche ende a knot, should be well seared with hoate waxe and rosen," etc. Mr. LEIGH here uses the length of 4 perches, or 66 ft., as if it was a well-understood standard and no new thing in his day.

Returning to the acre, we find that originally this term signified any cultivated field; and in its earliest form it was a pasture, hunting ground, or field of chase. Its dimensions were not defined, though one kind of acre was as much land as a yoke of oxen would plow in one day; and another as much land as could be sown with a given measure of a special kind of seed. This was a little, but not much, more definite than Paddy's dimension of the length of "this two-foot rule, my two fists, a stick, and a bit of a brick." It was not until the thirteenth century that the "acre" began to assume more exact dimensions as a specific quantity of land; but even then these dimensions varied widely with the location, or the crop gathered from the acre. Among old English acres we find 80 and 90 sq. perches as measuring "an acre of hops; 107, 110, and 120 perches as "a shut acre"; 130 to 180 perches as "a forest acre," etc.

Early in English history, and certainly antedating HENRY VIII, the common acre was accepted as being a piece of land 40 perches long and 4 perches in width. This was equal in area to the modern acre, but assumed a fixed ratio between the length and breadth of the strip of land. This laying out of cultivated lands in strips of comparatively narrow width is an exceedingly ancient custom still adhered to in Europe; and is shown on our own continent in the division of land borderin on the St. Lawrence river, near Quebec, and surveyed by the early French settlers. It was supposed to be better adapted to the methods of agriculture then in use, and as being a fairer division of land, especially if it was a pasturage, and access to a stream was a consideration.

But here again is the 66 ft. as the width of an acre and as one-tenth of its length. The short side of this acre was a very natural standard to adopt as a unit of land measure, and the 66-ft. chain would seem without doubt to have here taken its origin. We all know that "10 square chains make an acre;" but had the conventional acre been a *square* piece of ground, or of any other form than one whose sides were some multiple of 66 feet, it would be an exceedingly awkward task to divide it into 10 square chains. As a proof, let any one try this division with a *square* piece of ground having an area of 43,560 sq. ft.

The word "acre" is interesting in itself from its close adherence in form and sound, through many languages, to a very ancient root; showing it to be one of the primitive words, a term to denote a thing common to many lands and people. The new Century Dictionary traces it back as follows: Modern English, *acre;* Middle English, *aker, akir;* Anglo Saxon, *æcer;* Old Saxon, *akkar;* Old Freisland, *ekker;* Dutch, *akker;* Old High German, *ahhar, achar, accar;* Middle High German, *acker;* Icelandish, *akr;* Swedish, *aker;* Danish *ager;* Gothic, *akrs;* Latin, *ager;* Greek, *agros;* Sanskrit, *ajra.* All of these words are used in the sense of a field; originally a pasture, chase, or hunting ground. The theoretical original root is the Sanskrit *ag*, to drive. We get our modern form directly from the old French word *acre*, and that comes from the Law Latin *acra, acrum*, derived again from a Teutonic root.

But as "4 poles make 1 chain," it is interesting to expand the query, and seek the origin of "the rod, pole, or perch" as a smaller unit of land measure. Their names suggest their use and the general length, though we can find no authority at hand treating of their meaning in connection with surveying. The "rod" is Anglo-Saxon, unchanged in form and meaning; the "pole" is doubtless derived from *pal*, an Anglo-Saxon word meaning a stake or a flat, pointed piece of wood, a root which we retain in our word "pale," as used in fencing; and the "perch," as a unit of length, comes to us from the French *perche*, meaning a pole of any kind.

Each of these words signifies about the same thing, and an object which would be naturally used among a primitive people to designate comparatively short measurements. The farmer and traveller would use his staff for this purpose, the shepherd his crook, and the warrior his spear. The latter, approximating as it does closely to the length given the modern perch, suggests how this length might have been adopted originally. If HENRY I. based one standard upon the length of his arm, what would be more natural than to suppose that some one else of equal authority should fix upon the length of his spear as a longer standard? The spear was in almost every man's hand in the "good olden times," and in using it as a means of indicating distance, our ancestors paid little heed to the variation of a foot or two in its length. In fact, the ancient perch varied from somewhat less than 16 ft. to 28 ft. in length; which would go to show that, like the acre, the standard varied with the authority introducing it, and perhaps with the length of his particular spear. We give all this concerning the pole of 16½ ft., without specific authority and only as a seemingly logical conclusion. If any of our readers see fit to dig out further and better founded data, we should be pleased to hear from them.

## CORRESPONDENCE.

### Experiments with Lime and Brick-Dust Mortar.

GUADALAJARA, Mexico, July 8, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I was recently called on by two mill owners, using the same source of supply for water power, to make an equitable division of water, one being entitled to one-third and the other to two-thirds the flow of the stream.

The work necessitated the construction of a measuring weir, with lengths of crest proportional to the division required. It was, of course, important to build the weir as rapidly as possible, to reduce the suspension of work in the mills to the lowest limit of time.

Mexican lime, while remarkably fine, does not possess hydraulic qualities. So-called hydraulic lime is made in a town called Yula, but experiments proved it worthless, and, hydraulic cement not being at hand, the combination of ordinary lime and brick-dust was resorted to.

Having had no previous experience in the use of brick-dust and lime mortar, and having no time for experiments, the work was constructed with the proportion of two parts lime, one part brick-dust, and five parts sand. In ordinary work, mortar in the proportion of one part lime to four parts sand is usually employed in Mexico with good results.

While the heart of the masonry stood well, and finally became as hard as if laid in hydraulic cement, the parts exposed to wash failed, not having time to become sufficiently set to resist the action of the water. From subsequent experiments I attribute this partly to the lime not being perfectly slaked before use.

As it was impossible to delay the construction for a time sufficient to make experiments, Rosendale cement was procured at a heavy expense ($15 Mexican silver per cask) and employed in the exposed portions of the work.

I have since made exhaustive experiments with brick-dust and lime mortar, and, as other engineers may be called on to construct work under similar circumstances, I venture to submit the result of the investigations.

Equal parts of *unslaked* lime and brick-dust were first employed, but the mortar, under water, had no set whatever if used at once. This coincides with the experiments made with unslaked lime and Rosendale cement in concrete by Gen. JOHN NEWTON, Gen. Q. A. GILLMORE, and WM. E. WORTHEN, C. E., the results being embodied in their "Report to the Commissioners of Docks on the Bulkhead Walls at Canal and King Sts., New York." (Report 1876, p. 22.)

From numerous experiments the best results were obtained by first slaking the lime for at least four days, then carefully mixing with an equal portion of finely ground brick-dust, and allowing an initial set before immersion. I allowed two days for this set.

The following table shows breaking strength of briquettes:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| After 7 days' immers'n, tensile strength | 23 | lbs. | per | sq. | in. |
| " 14 | " | " | " | " | 42 | " | " | " | " |
| " 21 | " | " | " | " | 56 | " | " | " | " |

The samples were broken in a Fairbanks cement testing machine.

The results indicate that where hydraulic cement cannot readily be obtained, the substitution of lime and brick-dust is justifiable. Great care should be taken to mix the constituents and thoroughly slake the lime before use. While the set is slow, the mortar is decidedly hydraulic.

C. H. M. BLAKE.

### The First Brick Street Pavement in the United States.

CHARLESTON, W. VA., June 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of June 15, you publish, condensed from "The Michigan Engineer Annual," an article by Mr. EDGAR RYAN, on "Brick Street Pavements." He credits Bloomington, Ill., with having been the first city in the country to try the experiment of brick street roadways. This is a mistake. The writer laid, in this city, in 1870, what he believes to have been the first block of brick street pavement in America. It was considered by the knowing citizens very absurd and foolish, and predictions were freely made that it would be crushed to pieces within a week, or a month at farthest. Not a member of our City Council was willing to vote a dollar for it, and I put it down at my own expense.

After three years of constant and hard service (it being in the most trying position in the city), with no breaking or crushing, or appreciable wear, the city authorities were so far convinced of its value that they ordered another block put down, and paid for it. This was in 1873, and now, after 16 years constant use, it is in good and sound condition.

In all this time the direct wear and tear of the pavement has cost the city nothing for repairs; the only expense on it, and that has been but trifling, has been to

repair places carelessly relaid after having been dug up or sewers, water mains, gas, etc.

The first experimental block of pavement, above referred to, remained in use and good condition, without repairs, for about 11 years, when the city took it up to cut down and regrade the street, in order to pave it with brick from end to end.

The city has now in use several miles of this pavement, and contracts have just been let for laying about 40,000 sq. yds. more this season. Several other cities have tried it, are satisfied, and are laying more.

A prominent gentlemen and large property owner in our city, being written to by a friend in another State, for his estimate of the value of brick pavement, replied: "Our citizens, like all others, differ as to religion, politics, tariff, social questions, etc.; but in the conviction that brick pavements are the best and cheapest in existance, they are a unit."

The system of laying our pavement (which is covered by letter patent) is as follows: Upon the graded surface of the street, spread a layer of sand 3 ins. to 4 ins., which is brought to a smooth, uniform surface by a templet drawn over it; upon this place a layer of inch boards which have been steeped in hot gas tar; upon the boards spread another layer of sand about 1½ in., smoothed by templet, as before; then lay the brick on edge, preferably zig-zag, or, as brick masons call it "herring-bone style," after which put sand over the surface and sweep into the interstices between the brick. There are in use three methods of laying brick pavements,—1st, the method with board floor, just described; 2d, the double course of brick, on flat, and the other on edge, with necessary sand, etc., as laid in Bloomington and other Illinois towns; and 3d, brick laid on broken stone or concrete foundation, as now done in many cities.

By either method brick makes a cheap and good pavement. The board floor plan is the cheapest and is claimed to be the best, as it gives more uniform and better bearing for the brick, and, consequently, a smoother and more durably even surface to the pavement.

Of course good brick are a *sine qua non* for a good pavement. You can no more have a good pavement from inferior brick than durable clothes from shoddy cloth.

As the selection of material, of manufacture and degree of burning necessary for a suitable paving brick are getting to be better understood, adverse prejudice is giving way, and the conviction is rapidly gaining ground in the public mind that good hard brick is the cheapest and best paving material in the world.

J. P. HALE.

## The Ponce de Leon Artesian Well.

CHARLESTON, S. C., July 8, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I have read with interest your article on the Ponce de Leon artesian well, and was surprised at its enormous yield of water. Is there not an error in the "ten millions"? Ten million gallons in 24 hours is 6,944 galls. in one minute. This, with a bottom diameter of 5 ins., would give the enormous velocity of 1¼ miles per minute, if run through a 5-in. pipe, and taking the gallon equal to 231 cu. ft., or a cylinder 5 ins. in diameter by about 12 ins. long.

The temperature of this well, as given, is also somewhat singular. At 35 ft. it is 62° Fahr., a normal heat. At 170 ft. it is 74°, a rise of 12° in 135 ft., or 1° for every 11 ft. Then from 170 ft. to 350 ft. (180 ft.) the rise is only 2°, or 1° in 90 ft.; from 350 to 520 ft (170 ft.) the rise is only 3°, and from 520 to 1,110 ft. (or 590 ft.) the rise is given as only 1°, probably an error.

In Charleston we have now *four* artesian wells over 1,000 ft. deep. The one mentioned in your article is the first bored, 1,245 ft. deep. Three others have been bored since, as follows: (1) On Marion Square. Depth, 1,970 ft. diameter at top, 6 ins.; at bottom, 2⅛ in.; flow, 250,000 galls. daily, rise in pipe above surface, 105 ft.; temperature, 100° Fahr. (2) On George Street. Depth, 1,950 ft., diameter at top, 12 ins.; bottom, 3¼ ins.; flow, 350,000 galls.; rise above surface and temperature same as in preceding well. (3) On Hanover Street (unfinished). The present depth is 1,945 ft., with a bottom diameter of 5 ins. The contract calls for a depth of 2,000 ft., with a diameter of 4 ins. The yield, when last measured, was considably over 1,000,000 galls.; the temperature is 100°. When this well reached 1,835 ft., the flow from the other wells sensibly diminished. The amounts given here, however, are their present flow.

The water of these wells is the same; the taste is *not saline*, but slightly of soda, pleasant to the taste, very soft, and feeling delightfully in the bath. It cooks meats and most vegetables well, but gives a yellowish tinge to rice or hominy. We use it freely in our gardens for watering, and I have so used it in mine for eight years, and have never found it to hurt plants. In the washing of clothes it imparts a yellowish tinge when the clothes have been ironed; but if they are rinsed previously in cistern water, this tinge disappears.

Some of the most famous wells in the world are: The first Grenelle (1845); depth, 1,798 ft.; 600 galls. per minute; temperature, 82° Fahr. La Chapelle (1866); 5¼ ft. in diameter; 1,811 ft. deep. The Kissingen Salt Spring in Bavaria; 1,878 ft. deep; 66° temperature; projecting water 58 ft., due to carbonic acid gas, generated by a combination of gypsum and magnesian limestone. Passy well; depth, 1,925 ft.; bottom diameter, 2 ft. 4 ins.; yield, 5,500,000 galls.; temperature, 82°. The St. Louis well, depth, 3,147 ft.; briny salt water. The Sperenberg well in Prussia is the deepest bore. It is 4,197 ft. deep, 3,907 ft. of which is through salt.

Very truly,

A. DE CARADEUC,
*Asst. Engr. S. C. Railway.*

[Our record of flow and temperature at various depths was taken from the original record as kept by the contractor for sinking the well. We have no knowledge of the means taken to obtain these results or the accuracy with which they were observed. Our correspondent certainly makes a good point against the probability of such an extreme velocity as would be required to deliver this volume of water through a 5-in. pipe. The average increase in temperature in the total depth is about 1° in every 50 ft. of depth, which seems to agree fairly well with the range in other wells in that end of our country. There is a peculiarity in the intermediate temperature which we ourselves cannot understand. —ED. ENG. NEWS.]

## Elm Destroying Insects.

*Street Commissioner's Office,*
FLUSHING, N. Y., July 19, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Can you or any of your numerous subscribers furnish information as to the best method of stopping the ravages of the insect that has been destroying elm trees in this section of the country during the last three or four years?

Yours respectfully,

J. A. ROULLIER.

[Can any of our more experienced readers suggest a remedy for the above evil?—ED. ENG. NEWS.]

## The Degree of C. E. at Sheffield Scientific School.

HOLDERNESS, N. H., July 17, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I have just read your remarks in ENGINEERING NEWS, July 13, upon the conferring of degrees for C. E., and write to correct what seems to me a misunderstanding. You speak of "Yale College, 73 in all, from the Sheffield Scientific School." I gather that you mean to say that we turn out C. E's. at that rate every year, and I want you to know that the absurdity of conferring the degree of C. E. upon boys in course is a practice the Sheffield Scientific School has never been guilty of. The regular degree in course is Ph. B "Bachelor of Philosophy," and nothing more. To obtain C. E. the student must study *at least* one year longer, and engage in practice *at least* one year besides. The Sheffield Scientific School has not averaged over *one* degree in C. E. a year, for the last 30 years, and not one of its graduates ever received the degree of C. E. who had not studied at least five years and had at least one year of practice. I feel sure that, had you known these facts, you would have mentioned them, as they deserve to be mentioned in the connection of your remarks. The Sheffield Scientific School, as one of the oldest of our technical institutions, has thus been more chary of its degree of C. E. than any other; its requirements have always been more severe, and its diploma has always come nearer to the conditions you lay down than any other: it has always been the evidence, not only of a five years' course, but also of actual practical experience. I know no other of which this can be said, and it seems only right that these facts should be known.

I might also add that in electrical engineering we should have been on your list five years ago.

What has been said of C. E. applies also to D. E., or Dynamic Engineer or Mechanical Engineer. Of the 73 referred to by you, about 15 only had studied in the department of Civil Engineering, 19 in Mechanical Engineering, and the rest in Chemistry, Biology, and in the "Select Course," which is a course of general study designed to give a liberal scientific and literary education, without special reference to any profession. None of these 73 took either C. E. or D. E. They all received simply Ph. B.

Yours truly,

A. J. DU BOIS.

[While we must confess that our reference to the Sheffield Scientific School was somewhat ambiguous, we must fall back upon the New York contemporary which furnished us with the text for our note. But we are very much gratified to give further publicity to the facts set forth in the letter of Prof. DU BOIS, and to note that the school with which he is connected confers the degree of C. E only when it is earned, and can be worn with some credit to the young engineer and to the institution from which he has graduated. Our only purpose in writing our note was to point out the absurdity of the wholesale granting of meaningless titles, and we supplement what was then said with the hope that other similar institutions will follow the excellent example set them by the Sheffield Scientific School of Yale.—ED. ENG. NEWS.]

## The Hundred Foot and Gunter's Chain.

NEW YORK, July 17, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In connection with the query concerning the 100-ft. chain, I would say that Rees' Encyclopedia (the publication of which was commenced in 1802) after referring to the length of Gunter's chain, which it says is of particular advantage in finding the contents of a given field, remarks "that (the chain) ordinarily used for long distances is in length 100 ft., each link 1 ft. . . . For small parcels, or gardens, etc., is sometimes used a small chain of one pole, each link 1.98 ins. In measuring towns a chain of 50 ft. in length, consisting of 50 links, is the most commodious."

The same authority, quoting SCHEVENTERUS, says "A rope may contract ⅛ of its length when wet, and WOLFIN directs that the little strands whereof the rope consists be twisted contrarywise, and the rope dipped in boiling hot oil and when dry drawn through melted wax."

Sir GEORGE SCHUCKBURG, about 1780, had his chai made of steel, and corrected its length by allowing .06 ins. for 13½° of temperature.

That longer measures than 66 ft. were used seems to be evident by the ancient measuring line, called *scamus*, which was 145 ft. 1.104 in. English measure. The old Latin writers HORACE, OVID, PLINY and others, refer to the *decempeda*, or 10-ft. rod, also called the *pertica* being a rod which was the standard in measuring grant of land to the soldiers and so used before the Christian era.

In A. D. 1101, HENRY I. by a statute called *Compositio ulnarum et perticarum*, made the present standards of longitudinal measure, making the *ulnarum*, or arm measure the length of his own arm. The fathom was an old measure and given by PLINY as the length of both arms—as far as a man can spread his arms.

The present acre was established by EDWARD I. in 1252, and in 1500 HENRY VIII. made a statute to the same effect. He declared that the acre should be 16 perches in length and 10 perches in breadth.

It is evident from the above measure that the chain 66 ft. came in with the measure of acres, for which it is particularly adapted, and that previously chains were made of any convenient length, the foot being the basis. I have always supposed that the only part of the chain that originated with GUNTER was its division into one hundred parts for convenience in calculating and measuring acres. I think that a careful examination would show that the 100 ft. chain with its multiples was far older than the one of 66-ft. GUNTER invented his chain about 1606, centuries after the present standards were established.

Among modern references to chains 100 ft. long, you can find that in a "Treatise on Field Work" by PETER BRUFF, London, 1838, a chain of 100 ft., or a tape line, is advised. He also recommends a chain just double the length of GUNTER'S, divided into 100 parts, each link double the length of GUNTER'S, and in plotting to use a scale of double size.

JOHN C. GOODRIDGE, JR.

## The Bear-Trap Water Gate and Lehigh Coal

DU BOIS, PA., July 22, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

The Automatic Water Gate described in ENGINEERING NEWS of July 13th, the patent for which is claimed to be controlled by the Parker Automatic Water Gate Co., of Menominee, Wis., is an invention of more than two generations ago, with but slight variation in details. It has long been known as the "Bear-Trap Dam" for its resemblance to a contrivance of that kind.

These dams have been in use in the streams in this locality for a number of years. Mr. JOHN DU BOIS having adopted this form for the purpose of splash dams to float logs to his mills, the cutting of which is thereby continued throughout the whole year. The dams are built to raise a head of water from 5 to 7 ft. in depth, that being sufficient for all purposes required.

Instead of the folding upper "gate" or leaf and the "idler" or apron hinged to the down-stream leaf, as described in the Automatic Water Gate, the two leaves in the old Bear-Trap are similar, and the apron is attached to the up-stream leaf, allowing the down-stream leaf to slide under the upper one when lowered. The apron, being attached at the up stream end, protects the lower leaf from the shock and wear of the floating logs, and is held down by the water passing over it, and

no sand box or chisel-pointed metal toe is required to keep it down.

The dam is operated by two wickets placed, one at each end of a flume or bore bay. At one end of the dam an opening or port is placed in the side and bottom of the bore bay opposite the middle of the dam. The wickets are operated by levers. On closing the lower wicket and opening the upper one, the leaves are raised; vice versa when it is required to lower them. By a simple adjustment to equalize the flow of water through the wickets, the leaves will remain stationary at any point in the height provided for them to raise the water in the pool above.

A few years prior to Mr. Du Bois' death Mr. ARTHUR KIRK, of Pittsburg, was interested with him in experimenting with these dams. It was thought necessary to have a waste wier to relieve the hydrostatic pressure under the leaves, and an orifice was made in the lower end of the bore bay at a height at which the necessary pressure was exerted to raise and hold the dam against an overflow. On this point Mr. KIRK obtained a patent, and has since brought suit against the Du Bois estate to recover damages for the use of his patent. During the experimenting period, these discharge openings, or brackets as they were termed, were allowed, merely to test the experiment. But it has since been demonstrated that this is not necessary, and they are omitted, the height of the dam being regulated altogether by the wickets in the bore bay. Mr. Du Bois put one of these dams in Bennett's Branch of the Susquehanna river at Caledonia, Pa., having a length between the walls of 44 ft., which worked successfully.

The most extensive one constructed by him, or by any one else so far as known to the writer, was put in the Monongahela river near Pittsburg; a few years ago it was perfected and worked successfully, but owing to bad work in putting in the foundation, the crib work settled soon after its completion, thereby destroying its intended use. The length was 120 ft. The lawsuits that have followed and remain unsettled, have brought out a voluminous history of these dams, but for which they could be improved upon and made of great utility in the improvement of streams, waterways, and navigation.

In connection with the above account it may not be out of place to give a history of the origin of these dams and the importance attached to them in the development of the anthracite coal trade and the navigation of the Lehigh River in Pennsylvania, of which Mauch Chunk was the starting point.

After peace with Great Britain in 1783, a few scattered cabins might be found along the secluded valleys of the Lehigh and the Mahoning rivers, but with this exception the whole country was a vast howling wilderness. Dr. T. C. JAMES, who travelled in this region in 1804, thus describes it in a communication to the Pennsylvania Historical Society: "In the course of our pilgrimage we reached the summit of the Mauch Chunk mountain, the present site of the mine or rather quarry of anthracite coal. At that time, there were only to be seen three or four small pits, which had much the appearance of the commencement of rude wells, into one of which our guide descended with great ease, and threw up some pieces of coal for our examination; after which, whilst we lingered on the spot, contemplating the wildness of the scene, honest PHILIP GINTER amused us with the following narrative of the original discovery of this most valuable of minerals, now promising, from its general diffusion, so much of wealth and comfort to a great portion of Pennsylvania.

"He said, when he first took up his residence in that district of country, he built for himself a rough cabin in the forest, and supported his family by the proceeds of his rifle, being literally a hunter of the backwoods. The game he shot, including bear and deer, he carried to the nearest store, and exchanged for the other necessaries of life. But, at the particular time to which he then alluded, he was without a supply of food for his family, and after being out all day with his gun in quest of it, he was returning towards evening over the Mauch Chunk mountain, entirely unsuccessful and dispirited, having shot nothing. A drizzling rain beginning to fall, and the dusky night approaching, he bent his course homeward, considering himself as one of the most forsaken of human beings. As he trod slowly over the ground, his foot stumbled against something which, by the stroke, was driven before him; observing it to be black to distinguish which there was just light enough remaining, he took it up, and as he had often listened to the traditions of the country of the existence of coal in the vicinity, it occurred to him that this, perhaps, might be a portion of that "stone-coal" of which he had heard; he accordingly carefully took it with him to his cabin, and the next day carried it to Col. JACOB WEISS, residing at what was then known by the name of Fort Allen. The Colonel, who was alive to the subject, brought the specimen with him to Philadelphia, and submitted it to the inspection of JOHN NICHOLSON and MICHAEL HILLEGAS, Esqs., and CHARLES CIST, an intelligent printer, who ascertained its nature and qualities, and authorized the Colonel to satisfy GINTER for his discovery, upon his pointing out the precise spot where he found the coal. This was done by acceding to GINTER'S proposal of getting through the forms of the patent-office the title for a small tract of land which he supposed had never been taken up, comprising a mill seat on which he afterwards built the mill which afforded us the lodging of the preceding night, and which he afterwards was unhappily deprived of by the claim of a prior survey. HILLEGOS, CIST, WEISS, and some others, immediately after (about the beginning of the year 1792), formed themselves into what was called the "Lehigh Coal Mine Company," but without a charter of incorporation, and took up about 8,000 or 10,000 acres of, till then, unlocated land, including the Mauch Chunk mountain, but probably never worked the mine. It remained in a neglected state, being only used by the blacksmiths and people in the immediate vicinity, until somewhere about the year 1806, when WM. TURNBULL, Esq., had an ark constructed at Lausanne, which brought down two or three hundred bushels. This was sold to the manager of the water works for the use of the Centre square (site of the present new Public Buildings, Philadelphia) steam engine. It was then tried as an experiment, but only served to put the fire out: it was ultimately rejected as unmanageable, the remainder was broken up and spread on the walks in place of gravel. Its character for the time being blasted, the further attempts at introducing it to public notice in this way, seemed suspended."

"The Legislature was early aware of the importance of the navigation of the Lehigh river," says ERSKINE HAZARD, Esq., in a communication to the Historical Society; and the Lehigh Coal & Navigation Company, in a pamphlet published in 1840, said,—"That body in 1771 passed a law for its improvement: subsequent laws for the same object were enacted in 1791, 1794, 1798, 1810, 1814, and 1816. A company was formed under one of them, which expended upwards of $30,000 in clearing out channels, one of which they attempted to make through the ledges of slate which extend across the river, about seven miles above Allentown, but they found the slate too hard to pick, and too shelly to blow, and at length considered it an insuperable obstacle to the completion of the work, and relinquished it. The Coal Mine Company in the meanwhile anxious to have their property brought into notice, gave leases of their mines to different individuals in succession, for periods of 21, 14, and 10 years, adding to the last the privilege of taking timber from their lands for the purpose of floating the coal to market.

Messrs. J. CIST (the son of the printer), CHARLES MINER and J. A. CHAPMAN, who had the last lease, tempted by the high price of bituminous coal, made an attempt to work the mine, and probably would have succeeded, had not the peace reduced the price of the article too low for competition. They started several arks, only three of which reached the city. They abandoned the business at the close of the war, in 1815."

In 1812 Messrs. White & Howard, who were then manufacturing wire at the falls of Schuylkill, induced a number of individuals to associate and apply to the Legislature for a law for the improvement of the river Schuylkill. The coal which was said to be on the head waters of that river was held up as an inducement to the Legislature to make the grant, when the "Senator from Schuylkill County" asserted that there was no coal there—that there was a kind of "black stone" that was "called" coal but that it would not burn.

During the war, Virginia coal became very scarce, and Messrs. White & Hazard having been told by Mr. JOSHUA MALIN, that he had succeeded in making use of Lehigh coal in his rolling mill, procured a cart-load of it, which cost them $1 per bushel. This quantity was entirely wasted without getting up the requisite heat. Another cartload was however obtained, and a whole night spent in endeavoring to make a fire in the furnace, when the hands shut the furnace door and left the mill in despair. Fortunately one of them left his jacket in the mill, and returning for it in about half an hour, noticed that the door was red-hot, and upon opening it was surprised at finding the whole furnace at a glowing white heat. The other hands were summoned, and four separate parcels of iron were heated and rolled by the same fire before it required renewing. The furnace was then replenished, and as *letting it alone* had succeeded so well, it was concluded to try it again, and the experiment was repeated with the same result. In July, 1818, the Lehigh Navigation Company, and in October the Lehigh Coal Company was formed, which together were the foundations of the present Lehigh Coal & Navigation Co., as will appear by the preamble of their charter, passed in 1822. The improvement of the Lehigh was commenced in August, 1818. In 1820, only two years from the commencement, coal was sent to Philadelphia, by an artificial navigation, and sold at $8.40 per ton, delivered; 365 tons completely stocked the market.

In 1821 and 1822 the quantities were so much increased that the public became secure of a supply, and its own good qualities, together with its reasonable price, gave it an extensive and rapidly increasing demand. At this period anthracite coal may be said to be permanently introduced into use. In 1824 the Lehigh Company reduced the price of coal to $7; in 1825 coal first came to Philadelphia by the improved navigation of the Schuylkill—the quantity was 5,358 tons. In 1826 16,365 tons of coal were transported on the Schuylkill, and 31,280 tons on the Lehigh.

Nature did not furnish enough water, by the regular flow of the river, to keep the channels at the proper depth, owing to the very great fall in the river, and the consequent rapidity of its motion. It became necessary to accumulate water by artificial means, and let it off at stated periods, and let the boats pass down with the long wave thus formed, which filled up the channels. This was effected by constructing dams in the neighborhood of Mauch Chunk, in which were placed sluice-gates of a peculiar construction, invented for the purpose by JOSIAH WHITE (one of the managers), by means of which the water could be retained in the pool above until required for use. When the dam became full, and the water had run over it long enough for the river below the dam to acquire the depth of the ordinary flow of the river, the sluice-gates were let down, and the boats, which were lying in the pools above, passed down with the artificial flood. These dams were of the bear-trap pattern, and the first ever constructed. About 12 of these dams and sluices were made in 1819.

The boats used on this descending navigation consisted of square boxes or arks, from 16 to 18 ft. wide, and 20 to 25 ft. long. At first, two of them were joined together by hinges, to allow them to bend up and down in passing the dams and sluices; and as the men became accustomed to the work, and the channels were straightened and improved as experience dictated, the number of sections in each boat was increased, till at last their whole length reached 180 ft. They were steered with long oars, like a raft. Machinery was devised for joining and putting together the planks of which these boats were made, and the hands became so expert that five men would put one of the sections together and launch it in 45 minutes.

Boats of this description were used on the Lehigh till the end of the year 1851, when the Delaware division of the Pennsylvania canal was partially finished. In the last year 40,966 tons were sent down, which required so many boats to be built, that if they had all been joined in one length, they would have extended more than 13 miles.

These boats made but one trip, and were then broken up in the city, and the plank sold for lumber, the spikes, hinges, and other iron work, being returned to Mauch Chunk by land, a distance of 80 miles.

The descending navigation by artificial freshets on the Lehigh is the first on record which was used as a permanent thing; though it is stated that in the expedition in 1779, under Gen. SULLIVAN, Gen. JAMES CLINTON successfully made use of the expedient to extricate his division of the army from some difficulty on the east branch of the Susquehanna, by erecting a temporary dam across the outlet of Otsego lake, which accumulated water enough to float them, when let off, and carry them down the river.

N. S. MACMINN, C. E.

## RAILWAYS.

### EAST OF CHICAGO.—Existing Roads.

***Niagara Central.***—The survey of this line has been completed from Welland to within a few miles of the Humber at Toronto, Ont., and work is now in progress on the intervening section. The plans and profiles have been made and are now being filed with the clerks of the counties through which the road will pass preparatory to the early commencement of work. The road was projected to run from Niagara Falls to Toronto, Ont., a distance of 83 miles, and has been completed from Niagara Falls to Thorold, 13 miles. A. L. HOGG is engineer in charge of construction, with headquarters at Hamilton, Ont.

***Sandusky, Ashland & Coshocton.***—Construction has been commenced on this Ohio road at Sandusky, and work is now in rapid progress. The road is to run from Sandusky, O., via Ashland, to Coshocton, O., a distance of 93 miles. CHAS. A. JUDSON, of Sandusky, is Chief Engineer.

***Evansville & Terre Haute.***—Tracklaying has reached Odon, Daviess county, Ind., and work is being pushed.

***Toledo, Ann Arbor & North Michigan.***—President H. W. ASHLEY is quoted as saying that this road would be completed to Lake Michigan the present season, and that next year about 100 miles would be built by the company. The most important of these extensions will be the Chippewa Valley road running from Mount Pleasant to Big Rapids, Mich., 40 miles. GEO. L. DAVIS, of Cadillac, Mich., is Chief Engineer.

***Dexter & Piscataquis.***—The officers of this Maine company have filed a petition with the State Railroad Commissioners asking permission for a change of location into the town of Foxcroft, Me.

***Vaudreuil & Prescott.***—It is announced that construction has commenced on this road. The road is projected to run from Montreal, P. Q., to Ottawa, Ont.

***Whitefield & Jefferson.***—This company has obtained a charter for the extension of its road to Gorham and

Berlin, N. H., thence up the Androscoggin river, via Cambridge and Dummer to a point on the International boundary near Waumbeck Falls, N. H. A. L. BROWN, of Whitefield, N. H., is Superintendent.

*Pennsylvania.*—The Bayonne, N. J., City Council has taken legal action to prevent this company from building the Waverly & New York Bay R. R. through that town according to the present plans. The tracks are not at a sufficient elevation above the highways to permit of the passage of high vehicles.

*Canadian Pacific.*—A press dispatch from London states that the British Government has granted this company a subsidy of £500,000 yearly to aid in the establishment of a line of steamships running from the western terminus of the Canadian Pacific R. R. to China and Japan. The company's bonds are now being floated and the steamers being built.

*Columbus, Lima & Milwaukee.*—Stephen G. Clark, of Chicago, has the contract for building that portion of the line between Lima and Defiance, O., and work is now in progress under sub-contractor Wheeler. Work on the division from Columbus to Lima, O., will commence soon. B. C. FAUROT, of Lima, is President.

*Columbus, Hocking Valley & Toledo.*—Announcement has been made by President JOHN W. SHAW that default will be made in the interest of the 5 per cent. bonds on Sept. 1, and that the road would then probably go into the hands of a receiver. The alleged cause for the default is the falling off in traffic. The road depends mainly for its business upon the coal and iron, traffic, and the inability of the Hocking valley furnaces to compete with the southern furnaces in the production of iron and their consequent closing up, together with the small shipments of coal to the north and northwest has reduced business to such an extent that the above course is necessary. The amount in default will be about $200,000.

*Grand Trunk.*—Surveys have commenced on the proposed extension of the Haliburton branch to Mattawa, Ont. It is expected that the line will be completed by 1891.——The double tracking between Montreal and Cornwall, Ont., will be completed in about 3 weeks.

*Chicago & West Michigan.*—The contract for the extension from Baldwin to Traverse City, Mich., 75 miles, has been let to Fitzgerald & Co., of Lincoln, Neb. The road passes through a dense hard-wood forest for nearly the entire distance. The bridge across the Manistee river, which will be of iron, 1,200 ft. long and 80 ft. high, will be built independently. It is expected to have the road completed by July 1, 1890.

*Shepaug, Litchfield & Northern.*—A movement is on foot to build a branch from the main line near New Preston, Conn., west to Lake Waramaug, a distance of about 3 miles.

*South Mountain.*—The franchises of this road granted by the Legislature of Pennsylvania in 1854 will be sold by the sheriff at Lebanon, Pa., Aug. 10. The road was projected to run from Harrisburg to Slatington, Pa., 80 miles. About $400,000 was expended in grading a score of years ago and nothing has been done since.

*Cleveland & Western.*—It has been decided to change this road running from Delphos to Carey, O., 56 miles, to standard-gauge and to build an extension from Carey to Akron, O.

*New York & New England.*—It is "announced" that the contract has been let for the line from New York to Danbury, Ct., 59 miles. The story has been told so often before that it will find few believers now.

*Central R. R. of New Jersey.*—It is expected that tracklaying will commence on the Orange County Ry. running from Greycourt to Burnside, N. Y., 10¼ miles, about Aug. 1. The work has been very difficult, there being several earth cuts of 40-ft. and 50-ft. in depth and one rock cut, near Greycourt, 12-ft. deep and 300-ft. long. The iron bridge across the Otterkill river 150-ft. long is completed. At Greycourt the road crosses the Lehigh & Hudson River R. R. by a 44-ft. span iron bridge, which connects by a 30-ft. iron girder with the 94-ft. span iron bridge over the tracks of the New York, Lake Erie & Western R. R., and is then continued by a 7-span iron viaduct, 210-ft. in length to a connection with the 2,600-ft. wooden trestle going down to the Greycourt meadows. The highway bridges and culverts will be of iron and masonry. EVERETT GARRISON, of Newburg, is the engineer in charge of construction.

*Elmira, Cortland & Northern.*—Surveys are reported in progress for an extension from Elmira, N. Y., to Williamsport, Pa.

*Central New England & Western.*—The Hudson Connecting R. R. Co., and the Poughkeepsie & Connecticut R. R. Co. have consolidated under the above name. The Hudson Connecting R. R. running from Poughkeepsie to Campbell Hall, 29 miles, is completed, and the Poughkeepsie & Connecticut R. R., running from Poughkeepsie to Silvernails, is now under construction.

*New York Central & Hudson River.*—It is announced that this company has made arrangements with the Niagara Central R. R. Co. for an entrance into Toronto, Ont., over the line now being built from Niagara Falls to Toronto.

### Projects and Surveys.

*Falls Creek.*—Incorporated in Pennsylvania, with HENRY K. WICK, of Youngstown, O., President, to build a line of railway from Falls Creek Station in Clearfield county to London Mines in Jefferson county, a distance of 24 miles.

*Rome & Carthage.*—The surveys have been completed on 45 miles of this road from Rome north. The road is projected to run from Rome to Carthage, N. Y., 70 miles. A. C. KESSENGER, of Rome, N. Y., is interested.

*Hudson & Kinderhook.*—It is reported that the necessary funds have been raised to build this road, which is projected to run from Hudson to Kinderhook, N. Y., 16¼ miles. H. H. RICE, of Watertown, N. Y., is interested.

*Northern Colonization.*—It is announced that steps have been taken to begin the construction of this road from St. Jerome, P. Q., north. Hon. WILFRED PREVOST, of London, Ont., is a director.

*Quebec & Lower Province.*—An application has been made to the Quebec Legislature for a charter incorporating this company with power to build a railway from Levis, P. Q., through the districts of Quebec and Beauce, to a connection with the Canadian Pacific R. R. at Lake Megantic, Compton county.

*Lafayette Belt.*—Incorporated in Indiana with a capital stock of $25,000 to build a belt line railway around the city of Lafayette.

*Ohio & Northwestern.*—Surveys are in progress on this road which is to run from Smithton to Latrobe, Pa., a distance of 25 miles. JAMES CAMPBELL, of Allegheny City, Pa., is interested.

### SOUTHERN.--Existing Roads.

*Louisville & Nashville.*—During the past week contracts have been let for 13 more miles of the Big Stone Gap extension, beyond Cumberland Gap, making a total of 23 miles now under contract. The first eight miles were secured by Messrs. Winston Bros. & Co., of Minneapolis, Minn., and the remaining 5 miles by Walton & Co., of Roanoke, Va. Trains are to be running by June 15, 1890. The contracts for the proposed new union depot at Louisville, Ky., were also let during the past week, and the building will probably be ready for occupancy by the beginning of next year.

*Lookout Mountain.*—This company has let the contract for the 1 mile extension of their line at Chattanooga, Tenn., to George S. & S. W. Duncan.

*Newport News & Mississippi Valley.*—There is a rumor afloat that this company proposes to extend the Elizabethtown branch, built last year, from Hodgdenville, Ky., to Glasgow, 45 miles, thence to Scottsville, 25 miles further, where a connection would be made with the Chesapeake & Nashville, and thence 30 miles to Gallatin, Tenn., tapping at this point the Louisville & Nashville. The citizens of Hardin, Barren and Allen counties, Ky., are very anxious to have the road built, and have subscribed money enough to secure the right of way. Surveys will shortly be made.

*Knoxville Southern.*—S. P. Condon has the contract for constructing the road through the mountains south of the Hiawassee river and between that stream and Ducktown, Tenn. There are 3 tunnels on the line, one 1,200 ft., one 700 ft., and one 300 ft.

*Decatur, Chesapeake & New Orleans.*—Work on this road is steadily progressing, and tracklaying will soon begin at Fayetteville, Tenn.

*Atlanta & Florida.*—The citizens of Atlanta, Ga., are agitating the question of having this company extend its line from Fort Valley, the present terminus, to Cordele, 42 miles, to connect with the South Brunswick Terminal R. R., thus giving a direct route from Atlanta to the seaboard.

*South Brunswick Terminal.*—Work is progressing rapidly on the construction of this road from Brunswick, Ga., to Cordele, 600 hands being employed. Gen. JOHN J. HOLLY, New York, is President.——The officials positively deny the rumor that the road has been purchased by the Plant syndicate.

*Columbus Southern.*—The Georgia Senate has passed a bill authorizing this company to extend its track to the Florida line.——A shipment of 1,000 tons of rails arrived at Columbus last week, and they will be laid at once.

*Darien Short Line.*—Tracklaying on this road will be commenced shortly. R. K. WALKER, Darien, Ga., is President.

*South Bound.*—The subscription of Savannah, Ga. for this road has reached $40,000 and is daily increasing. All the right of way has been secured from Columbia, S. C., to Sister's Ferry, on the Savannah river, and right of way agents are at work between that place and Savannah. HERMAN MYERS is President.

*Huntsville Belt Line & Monte Sano.*—This road has been completed from Huntsville, Ala., to Hotel Monte Sano, a distance of 8 miles. A portion of the track was laid in 1888.

*Alabama, Florida & Atlantic.*—A press report from Orlando, Fla., states that this road has been sold to an English syndicate which will complete the road. The road was graded from Eustis to Altamonte, Fla., 22 miles, in 1887, but nothing has been done since. Dr. J. O. BRONSON, of Indian Springs, Fla., was the projector of the enterprise.

*Western & Atlantic.*—The present lease of this road expires December, 1890, and a bill is now before the Georgia Legislature authorizing the Governor to lease the road anew and stating the terms and conditions by which the new lessee must be bound. The bill provides that the minimum rental shall be $35,000 per month, the lease being for a period not less than 20 years. The bill also provides that proposals for the lease shall be advertised for during one month after its passage. Probably the Cincinnati Southern, the Louisville & Nashville, the Central R. R. of Ga., and the Richmond & Danville will be among the bidders. There is also some rumor of a private company being organized in Atlanta for the purpose of obtaining control of the road.

*Savannah, Americus & Montgomery.*—Engineer ALLEN of this road has begun the survey of a belt line at Cordele, Ga., for the purpose of giving railroad facilities to the various manufacturing enterprises about to be located there. The line will run from the Savannah, Americus & Montgomery tracks on the south side of the town to those of the Georgia Southern & Florida, on the north, and will be used by both roads.

*Alabama Midland.*—This road has been stopped from using a portion of its right of way by an injunction obtained by the Central R. R. of Ga., and an extra session of the supreme court is now considering the case. Until a decision in the matter is reached, work is at a standstill. Should the court refuse to dissolve the injunction, the route of the road will have to be changed.

*East Tennessee, Virginia & Georgia.*—Work on the Birmingham, Briarfield and Blocton division is progressing very rapidly, and the grading will soon be finished to Bessemer. It is expected that trains will be running over the new road from Birmingham to Mobile before the close of the year. The company also expects to build several branches in and around Birmingham to the various mines and manufacturing enterprises located there.

*North Beach.*—T. L. Marquis, who has the contract for grading this road near St. Augustine, Fla., began work Monday last with a force of 75 men. The road is to be completed by January 1, 1890.

*Roanoke & Southern.*—The citizens of Roanoke, Va., are desirious of having this road completed, and it is stated that the officials have come to the determination to begin work on that end of the line as soon as possible. Work is progressing in the vicinity of Winston, N. C.

*Lynchburg & Durham.*—At a recent meeting of the board of directors of this company, President OTEO reported that the road was now open to Brookneal, Va., and would be completed to South Boston by September 1.

*Norfolk & Western.*—The route by which the Cripple Creek extension will reach North Carolina has been settled. It will run from Ivanhoe up New river 21 miles to the mouth of Meadow Creek, thence following Meadow creek in a southeasterly direction to near its head; thence through Low Gap to Blue Ridge, and running east to a point on the North Carolina line, 4 miles from Mount Airy, where it will be met by the Cape Fear & Yadkin Valley R. R.

*Norfolk & Carolina.*—The entire grading of this road, running southwest from Norfolk, Va., has been completed. Rails have been laid as far as Nansemond county, N. C., and are now being laid westward. One of the official states that the whole road will be in operation by Oct. 15.

*Statesville Air Line.*—Reports from Winston, N. C., state that work on this road is making good progress.

*Hartsville.*—It is expected that this new South Carolina road will be opened for business in a few days. J. L. COKER of Hartsville, S. C., is President.

*Burgaw & Onslow.*—Right of way has been secured in the vicinity of Swansboro, N. C., and the inhabitants of that locality are anxions to have that place the terminus of the road.

*West Virginia Central.*—Surveys are being made by Engineer PARSONS for a branch line to run up Stony river.

*Clarksburg, Weston & Midland.*—Surveys are in progress for an extension of this West Virginia road 45 miles into Braxton county to a point on Elk river. Contracts will probably be let about Aug. 15. J. N. CAMDEN, of Parkersburg, is interested.

*Wilmington & Weldon.*—The grading on the extension from near Bethel south to Greenville, N. C., 14 miles, has been completed and tracklaying is now in progress.

*Columbia, Newberry & Laurens.*—Rice & Coleman, Chester, S. C., have the contract for the trestle work between Columbia and Newberry, S. C., and also for 18 miles of grading, completing the line to Newberry.

*Green Pond, Walterboro & Branchville.*—The commissioners of Colleton county, S. C., have signed an agreement with JOHN C. MALLONEE, Charleston, S. C., for the sale of this road. He represents capitalists who will complete its construction.

### Projects and Surveys.

*Orlando & Indian River.*—M. R. MARKS, of Orlando, Fla., has given us the following information concerning this enterprise, of which he is at the head:

The road is projected to run from Orlando via Runnymede and south of Lake Washington to a terminus on the Indian river at Melbourne, a distance of about 70 miles. The preliminary surveys have been made. The road will run through some of the finest fruit growing and timber land in the State. The route is through a

rolling prairie country affording very easy grades and curves. Efforts are now being made to secure the capital necessary to build the line. OTTO FRIES, of Orlando, is Chief Engineer.

*Georgia.*—Bills have been introduced into the Georgia State Legislature to incorporate the following railway companies: The Atlanta & Lithonia R. R. Co.; the South Bound R. R. Co.; the Bainbridge, Cuthbert & Western R. R. Co.; the Collins Park & Belt R. R. Co.; the Richmond County Belt Line R. R. Co.; the Fort Payne & Eastern R. R. Co.; the Rome, Subligna & Northern R. R. Co., and the Calhoun & Fairmount R. R. Co.

*Palatka & Lake Shore.*—The surveys will soon commence on this road, a notice of whose incorporation was given in our issue of July 13.

*Chattanooga & Virginia R. R. & Transportation Co.*—JOHN A. MOON and A. W. CHAMBLISS will apply for a charter incorporating the above company to build a railway and establish a steamboat line for carrying coal from Virginia to Chattanooga, Tenn.

*Fort Payne & Eastern.*—This company proposes to build a railway from Fort Payne, Ala., to Gainesville, Ga.

*St. Johns & De Land.*—This railway company has been organized in Florida with the following officers: J. B. STETSON, of Philadelphia, Pa., President; GEORGE CECIL, Vice-President, and CHARLES A. MILLER, Secretary.

*Missouri, Tennessee & Georgia.*—W. A. CRAWLEY, Vice-President of this road, states that the proposed railway between Humboldt and Hickman, Ky., 85 miles, will be built by this company, and that a locating survey will shortly be made and construction commence as soon as possible. L. B. WRIGHT is President and J. J. WILLIAMS, Chief Engineer.

*Rome & Northeastern.*—The charter of this road has been purchased by Nashville, Tenn., capitalists and it is stated that the road will be built at once from Rome, Ga., northeast through the counties of Barstow, Cherokee and Forsyth. The object of the road is to develop the mineral lands along the route.

*Albany & Cordele.*—It is stated that money is being raised to defray the expenses of a survey for a railway from Albany, Ga., to Cordele, Ga.

*Murphy & Tallulah Falls.*—A project is on foot to build a line of railway from Murphy, N. C., to Tallulah Falls, Ga., a distance of about 45 miles.

*Waco & Bowden.*—A railway company by this name has been incorporated in Georgia.

*South Atlantic & Northwestern.*—This old project to build a railway from Southport, N. C., to Bristol, Tenn., has been revived. It is announced that the capital necessary to build the line has been secured and that the road will be pushed rapidly to completion.

*Kentucky & Tennessee.*—This company, chartered in 1871, has submitted a proposition to the city of Hopkinsville, Ky., to build a line of railway from that place to a connection with the Chesapeake & Ohio R. R., on condition that $100,000 be subscribed in aid of the road by the citizens.

*West Florida & Alabama.*—In addition to the information from the President, J. D. PIRRONG, regarding this enterprise, published last week, we have obtained the following through a personal interview with J. H. HAMILTON, Secretary of the company.

The road as now projected will extend from Eufaula, Ala., via Chipley, Mariana or Cottondale, Fla., (probably the latter), south to St. Andrews Bay. From this point two lines are to be built, one running east to the dead lakes of the Appalachicola river and thence south to St. Joseph, the other running direct to St. Joseph, along the coast. From St. Joseph the road will continue to a terminus at Appalachicola. An old partially graded road-bed runs from Chipley to St. Andrew's Bay, part of which may be utilized. The region traversed by the road is neither barren nor swampy, but is excellent farming land; and cotton, sugar cane, tropical fruits and other staples do well. The pine timber tracts traversed are of great value, and will alone furnish a heavy traffic at the start. St. Andrews and St. Josephs have as great natural advantages as any ports on the Gulf. The locality is a favorite resort for Southerners in the summer, and it is designed to make it a winter resort for Northerners as well. The climate and the excellent fishing, boating, and bathing at St. Andrew's and St. Joseph's bays make it exceptionally attractive. A large tract of well settled farming country, now cut off from river traffic by the dead lakes of the Appalachicola will be given an outlet by this road. The company has a broad charter empowering it to build either a standard or narrow gauge road. The people along the lines are very desirous of the road, and subscriptions in lands and cash have been promised for large amounts. The New York office of the company is at 18 Broadway.

### NORTHWEST.—Existing Roads.

*Winona & Southwestern.*—It is thought that work will soon commence on the line from Bear Creek Station to Mason City, Ia., a distance of 117 miles. There will be two tunnels 1,825 ft. and 475 ft. long and 3 iron bridges 900 ft., 700 ft., and 510 ft. long respectively, on the line. A 2,000-ft. iron bridge will be built across the Mississippi river at Winona. The definite location of the proposed extension south from Mason City has not been decided upon. D. W. WHEELER, of Winona, Minn., is Chief Engineer and Superintendent.

*Grand Tower & Cape Girardeau.*—The foundations of the bridge across the Big Muddy river have been completed and work on the superstructure is now in progress. The bridge will be 300 ft. long.

*Sioux City & Northern.*—The contract for building this road has been let to E. P. Reynolds & Co. Work will commence north of Maurice, Ia., and the section from that place north will be built first. The grading is to be completed by Nov. 1.

*Missouri Pacific.*—Reports are in circulation that this company intends to build an extension from Omaha, Neb., to Yankton, Dak.

*Chicago, Burlington & Quincy.*—About 3 miles of the Denver, Utah & Pacific R. R. has been changed to standard gauge and work is being continued.

*Great Northwestern R. R. of Canada.*—C. S. DRUMMOND, of Winnipeg, Man., sends us the following:

The company was incorporated in April, 1889, to build a line of railway about 450 miles long in Manitoba and the Canadian Northwest. The road runs through a rolling prairie country. There will be three large bridges. The principal business of the road will be in grain, minerals, and oil. The capital to build the line will be furnished by London capitalists.

*Goodyear, Neillsville & Northern.*—N. R. RICHARDSON, of Tomah, Wis., Secretary, has furnished us with the following information:

The road is now being constructed from Goodyear Station, on the Goodyear branch of the Chicago, Milwaukee & St. Paul R. R., to Neillsville, Wis., a distance of about 20 or 25 miles. Of this, 5 miles are in operation as a logging road and about 10 miles of the remainder has been surveyed. The route as surveyed affords a very favorable line. The object of the road is to open up a large belt of pine and hard wood timber and to transport stone from quarries along the route. For the present the road is operated as a logging road only, but it will ultimately do both a freight and passenger business. The company was incorporated May 24, 1889. The officers of the company are: D. A. GOODYEAR, President; C. A. GOODYEAR, Vice-President and General Manager, both of Tomah, Wis.; and Y. V. BEEBE, of New Lisbon, Wis., is Chief Engineer.

*Yankton, Norfolk & Southeastern.*—Jones Bros., of Yankton, Dak., have the contract for grading this road and work is to be commence at once. The road is to run from Yankton to Norfolk, Neb., 70 miles. D. C. RICE, of Yankton, is Chief Engineer.

*Louisville, Evansville & St. Louis.*—The locating surveys between Belleville and Mount Vernon, Ill., 67 miles, have been completed and construction is now in progress. The work is being done under the personal supervision of President D. J. MACKEY, who expects to have the line completed by September 15. Mr. MACKEY'S headquarters are at the Gay Building, St. Louis, Mo.

*Canadian Pacific*—Morton, Rose & Co., of London, England, have raised all the money to build the Regina & Long Lake Railway, from Regina, on the Canadian Pacific, to Prince Albert, 250 miles. The contract for the whole work, including rails, stations, tanks, grading, bridging, etc., has been let to James Ross, who built the Canadian Pacific in the same district and over the Rocky, Selkirk and Gould mountains, and who lately finished for the Canadian Pacific the short line in Canada. Men have been sent up to start the work. The contract is to be completed in December, 1890.

### Projects and Surveys.

*Duluth, Milbank, Huron & Chamberlain.*—The officers of this company, which proposes to build a railway from Morris, Minn., via Milbank and Huron to Chamberlain, Dak., a distance of about 210 miles, are D. W. DIGGS, of Milbank, Dak., President; Col. W. H. LAMB, of Clark, Dak., Vice-President; IRVING BALCH, of Milbank, Secretary, and J. T. STERNS, of Chamberlain, Treasurer.

*Milbank, Egan & Sioux City.*—The organization of this company has been completed with the election of the following officers: WM. M. BROOKE, of Brookings, Dak., President; J. H. ENO, of Eagan, Dak., first Vice-President; HENRY T. VALKMAN, of Milbank, Dak., second Vice-President; W. B. SAUNDERS, of Milbank, Treasurer, and D. W. DIGGS, of Milbank, Secretary. The road is projected to run from Milbank to Palisades, Dak., a distance of about 85 miles.

*Black Hills Central.*—Organized in Dakota to build a railway from Rapid City west into the Black Hills, a distance of 60 miles.

### SOUTHWEST.—Existing Roads.

*Kansas City, Wyandotte & Northwestern.*—Track has been laid on this road from Axtell to Summerfield, Kan., since Jan. 1, 1889. The line from Lawrence to Wichita, Kan., is now under survey.

*Kansas City & Southern.*—About 400 men are now at work improving the roadbed between Kansas City and Osceola, Mo. It is thought that an extension south to a connection with the St. Louis & San Francisco R. R. will be built this year.

*Chicago, St. Paul & Kansas City.*—General Manager JOHN M. EGAN is quoted as saying that unless a loan could be negotiated, the proposed branch from Savannah to Rockport, Mo., 55 miles, would not be built this year.

*Louisville, New Orleans & Texas.*—Work on the Helena, Ark., transfer has been commenced under the direction of J. W. STANSELL, of Memphis, Tenn. Capt. FORREST, of Memphis, is reported to have the contract for the earth work.

*Red River, Sabine & Western.*—The engineers have completed the preliminary surveys to New Birmingham, Tex., and are now at work locating the line between Palestine, Tex., and New Birmingham. The road is projected to run from Fort Worth, Tex., to Alexandria, La., 345 miles. The contract for building the division from San Augustine, Tex., to Nacogdoches, La., has been let to the Fort Worth Construction Co., and work is now in progress. L. W. LLOYD, of Nacogdoches, La., is President.

*San Antonio & Aransas Pass.*—The engineers of this company are now locating the line from Kennedy Junction to Laredo, Tex. It is expected that construction will commence in about 2 months and the road be pushed rapidly to completion.

*New Orleans, Ft. Jackson & Grand Isle.*—C. S. DWIGHT, Chief Engineer and Superintendent, writes us that good progress is being made on construction and that tracklaying will soon begin.

*Texarkana Northern.*—Grading has commenced on this line west of the Red river. A large force is at work and grading is being pushed.

*Arkansas Midland.*—This road, now in operation from Helena to Clarendon, Ark., 48 miles, will be relaid with new steel rails. The old iron will be used on two branch lines to be constructed from the main line to Indian bay and Old Town ridge, 18 and 12 miles respectively. The proposed extension to Little Rock will not be built until next year.

*Chicago, Rock Island & Pacific.*—The grading on the line from Pond creek to Kingfisher, Ind. Ter., is now well under way, about 10 miles having been completed. Tracklaying will commence soon and it is expected that the road will becompleted to Kingfisher by Sept. 15.

*Greenfield & Northern.*—About 5 miles of this road north from Greenfield, Mo., has been graded and work is in active progress on the remaining 20 miles to Stocton. T. A. Miller is the contractor. L. W. SHAFER, of Greenfield, is President.

*Shreveport & Texarkana.*—Track laying will soon begin on this road which is to run from Texarkara, Ark., to Shreveport, La., about 75 miles. The line is being built by the Gate City Lumber Co. and a portion has been in operation some time as a lumber road. R. T. COLE, of Shreveport, is President.

*Denison & Washita Valley.*—Work will commence on this road as soon as contracts can be let. The branch from Fort Smith, Ark., west via Oklahoma and Fort Reno, Idaho, to Halifax, N. M., will be constructed first. Major L. S. SHELLENBERGER, of Denison, Tex., is Chief Engineer.

*Fort Worth & Rio Grande.*—Good progress is being made on the extension from Granbury to Brownwood, Tex., 108 miles. The road is being ballasted with rock. Hurley, Tierney & Lynch have the contract for grading and bridging 60 miles of the line.

### Projects and Surveys.

*Little Rock & Alexandria.*—A construction company has been formed to build this road from Little Rock, Ark., to Alexandria, La., about 250 miles. B. A. JOHNSON, of Camden, Ark., is President.

*Kansas City, Lawrence & Nebraska.*—At the annual meeting of the stockholders recently held the following officers were elected: W. H. CHICK, Kansas City, President; J. M. WEBSTER, of New York, Vice-President; JNO. M. JEWETT, Lawrence, Kan., Secretary, and I. N. VAN HOESEN, of Lawrence, Treasurer.

*Texas Pacific Coal Co.*—This company is considering the building of a railway from its coal mines to Stephenville, Tex., about 27 miles.

*Louisiana, Arkansas & Missouri.*—We are informed that the contract for building 81 miles of this road from Trippe Junction, Ark., to Delhi, La., has been let to the Fruin-Bambrick Construction Co., of St. Louis, Mo. The road is projected to run from Brinkley, Ark., to New Orleans, La. The portion now under contract is to be completed ready for tracklaying by Oct. 1, 1890. The contracts for the sections from Trippe Junction north to Brinkley and from Delhi south will be let early in the spring of 1890.

### ROCKY MT. AND PAC.—Existing Roads.

*Union Pacific.*—The Denver, South Park & Pacific R. R. in which this company has a proprietary interest has been sold to Messrs. TAPPAN, HOLLISTER, and TEELAND, representing the stockholders. It is stated that the owners will reorganize under the name of the Denver, Leadville & Gunnison R. R. Co., with a capital stock of $3,000,000. The line will still be operated by the Union Pacific. A large force of men are now at work grading the short cut from Erie, via Lafayette to Buffalo Hill, Colo. It is expected that grading will be completed by Aug. 15, and tracklaying begin about Sept. 1.

*Northern Pacific.*—At a meeting of the directors recently held it was decided not to declare a dividend, but to issue $15,000,000 worth of bonds in lieu of dividends.—Rapid progress is being made on the Gallatin-Butte extension.

*Pacific Short Line.*—Engineers are now at work locating the route for the Salt Lake Valley & Eastern R. R. through the Ogden Cañon. It is expected that the surveys will be completed by Aug. 15, and contracts let immediately after.

*Oregon Railway & Navigation Co.*—Track laying

on the line from Tekoa, via Oakesdale, to Winona Junction, W. T., has reached a point within 5 miles of Oakesdale

***Astoria & South Coast.***—Surveys are in progress for the extension from Young's Bay, via Astoria, south to the coast. Construction will commence as soon as 10 miles of the line has been located. It is expected to let contracts by Aug. 5.

**Projects and Surveys.**

***Ellensburg & Northeastern.***—A press dispatch from Ellensburg, W. T., states that construction has commenced on this road at that place. Bids for grading the first 10 miles have been called for. JOHN A. SHOUDY, of Ellensburg, is President.

**FOREIGN.**

***Mexican National.***—It is announced that negotiations are in progress for the construction of the Galveston & Western R.R. from Collins, Tex., to Galveston, Tex. The road will be made standard gauge to operate in connection with the Texas Mexican R. R. which will be made standard gauge from Collins to Laredo, Tex. Engineers are now relocating the extension of the Matamoras branch to Laredo.

***Congo.***—The necessary funds for the construction of this road, which is projected to run from the Lower Falls of the Congo river to Stanley Pool, about 260 miles, have been subscribed by the Belgian Government and American and English capitalists. There is also talk of an English syndicate building a road from the Zanzibar coast to Victoria Nyanza, a distance of about 400 miles.

## RAPID TRANSIT.

**Street Railways.**—***Pittsburg, Pa.***—The Pittsburg, Oakland & East Liberty Passenger Ry. Co. has been granted permission to build on several streets.

***Athens, Ga.***—The street railway was sold July 17 to E. G. HARRIS, of Macon, Ga., for $6,700. The company which he represents will improve and extend the line at a cost of $20,000.

***Savannah, Ga.***—The Enterprise Street Ry. Co. has applied to the State legislature for a charter. Capital stock, $100,000.

***Greenville, Ala.***—A street railway company has been organized, and has purchased track material.

***Cincinnati, O.***—GEO. B. KERPER and his associates have been granted the right to construct a double track road on the Montgomery turnpike.

***Defiance, O.***—The Defiance Street Ry. Co. has been incorporated. Capital stock, $25,000.

***Dayton, O.***—The Dayton & Soldiers' Home Ry. Co. has been incorporated. Capital stock, $100,000.

***West Superior, Wis.***—A 30-years' franchise has been granted to the street railway company. Work will be commenced at once on 4 miles of extensions.

***Salt Lake City, Utah.***—A large amount of stock of the street railway company has been taken by the Jarvis & Conklin Mortgage Trust Co., of New York. The line will be improved and 7½ miles of track will be completed by August.

***Helena, Mont.***—Street railway franchises have been granted to R. A. HARLOW and DONALD BRADFORD, and to MICHAEL H. KEEFE and associates.

***Tacoma, W. T.***—The Tacoma Central Street Railway Co. has been incorporated by W. H. TISDALE, JOHN S. BAKER and JAS. S. BOYLE. Capital stock, $40,000.

***Olympia, W. T.***—Mr. SAVAGE has let the contract for the surveys of the Fourth street & North Olympia street railway, to Whitman & Brown.

***Houston, Tex.***—The Houston Belt & Magnolia Park Railway Co. will hold a meeting at Houston, on September 16 to authorize a mortgage on the property and franchises; the proceeds to be expended in the construction and equipment of the road.

**Electric Railways.**—***Beverly, Mass.***—A correspondent sends us the following: An electric railway is being built from Beverly to Danvers, about 3½ miles, by the Beverly & Danvers Electric Railway Co.; President, JOHN I. BAKER. The storage system controlled by the Westinghouse Co. is used, and the plant is furnished by the Union Car Co., more than half of the track has been laid, the power house at Beverly is under way, and it is expected that the road will be in operation by the latter part of the summer. The company proposes to have the use of the Naumkeag Street Railway Co's. lines which extend through Salem, Beverly, Danvers, Peabody, etc.

***Jamaica, N. Y.***—The Jamaica & Brooklyn Electric Ry. Co. has awarded to Patrick Conway, of Brooklyn, the contract for a double track road between East New York and Woodhaven, and a single track from Woodhaven to Jamaica.

***Buffalo, N. Y.***—The Buffalo Street Ry. Co. opened its electric line to Cold Springs on July 20. The Sprague system is used, with overhead wires, and there are two Edison dynamos, driven by a Ball engine of 150 H. P. Four cars have been equipped for this service.

***Pittsburg, Pa.***—The Pittsburg & Birmingham street railway has been purchased by a syndicate, and will be converted into an electric road. M. VENNER, Superintendent of the Citizens' Traction Co. will have charge of the work.

***Richmond, Va.***—The Richmond City Ry. Co. is improving and extending its road, and putting in an electric system.

***Covington, Ky.***—Surveys have been made for the electric railway. Mr. ABBOTT is president of the company.

***Augusta, Ga.***—The Augusta Street Ry. Co. proposes to put in an electric system.

***Zanesville, O.***—A franchise has been granted to the electric street railway company.

***Akron, O.***—Additional franchises have been granted to the Electric Street Ry. Co., and bonds for $20,000 have been given to complete 12 miles within a year. Gen. CASEMENT is President, and S. F. EVERETT, of Cleveland, Vice-President.

***Toledo, O.***—The Toledo Electric Ry. Co. has been incorporated and will purchase the new road which is operated on the Thomson-Houston system. Capital stock, $50,000.

***Hamilton, O.***—The Hamilton Electric Street Ry. Co. has been organized. President, ELLIS POTTER; Vice-President, E. B. RODGERS.—The Hamilton & Lindenwald Electric Transit Co. has been incorporated by D. D. MILLIKEN, P. BENNINGHOFER, and J. J. MCMACKIN.

***Cleveland, O.***—The Scranton Ave. Street Ry. Co. has applied for power to adopt electric traction.—The Sprague system has been adopted for the Broadway and Newburg line.

***Indianapolis, Ind.***—The council has granted permission to the Julien Electric Motor Co., of New York, to experiment with its electric storage system.

***Omaha, Neb.***—The Omaha Street Ry. Co. will build two electric lines to South Omaha.

***Seattle, W. T.***—The Seattle Electric Ry. Co. will build its line to the lake, but will abandon the Madison St. route and choose a different one.

**Cable Railways.**—***New York, N. Y.***—The Third Ave. Ry. Co. has applied to the Railroad Commissioners for power to adopt a cable system.

***Newark, N. J.***—The Council has directed that the cable line in Market St. and Springfield Ave. be removed. The line is owned by the Essex Passenger Ry. Co. and it is admitted that it cannot be operated. It was built by F. E. Hinckley & Co., of Chicago, at a cost of $175,000. The cable is of a special pattern, intended to drive the car by a sprocket wheel.

***Cleveland, O.***—The Cleveland City Street Ry. Co. has increased its capital stock from $100,000 to $4,000,000. Work will be commenced in August and 3 miles built this season. The total length is to be 32 miles. FRANK ROBISON is President and JOHN KOCH, Vice-President.

***Kansas City, Mo.***—The Union Cable Ry. Co.'s line will soon be completed by the construction company of which Mr. JOSHUA BROWN is the head. The Terry system, with a shallow conduit, is employed.

***Omaha, Neb.***—The Metropolitan Cable Tramway Co. has been sued for $217,750.85 by A. N. LIGHTHALL, an engineer with whom the company made a contract for the construction of a cable railway, and he was to organize a company to build the road and take bonds in payment. He purchased yokes, rails, driving plant and a cable, and then the company failed to carry out its agreement with him.

***Seattle, W. T.***—The council has granted a franchise to J. M. THOMPSON and others to build a cable railroad on Madison St., from the harbor to Lake Washington. Work will be begun immediately, and prosecuted night and day. Another company recently commenced work under a franchise granted five years ago, but since lapsed. The matter will probably be taken into the courts.

NEW ELECTRIC LIGHT STATION AT SALEM, MASS.—The Salem Electric Light Co., finding its present station inadequate, is now erecting a new one designed by the Thomson-Houston Electric Co. The boiler house is independent of the building containing the engines and dynamos. The engine and dynamo house is two stories high, the first story, where the engines are situated, being 14 ft., and the second, where the electrial apparatus is placed, being 12 ft. This building is 102 x 56 ft., built of brick throughout. The boiler house is 92 ft. x 54 ft. 4 ins. and 23 ft. high. The chimney is 130 ft. high, 6 ft. inside diameter, and 13 ft. square at the base. The foundations are rubble stone placed on piling capped with concrete: 708 spruce piles were used under the main building, and 52 oak piles under the chimney. The steam plant consists of one 350 H. P. double tandem compound engine, made by McIntosh & Seymour, and one 150 H. P. high pressure Fitchburg engine, now in use at the present station. The 3 boilers were made by the Cunningham Iron Works; they are 6 ft. diameter, 17 ft. long, and 125 H. P. each. The auxiliary steam apparatus consists of one 1,200 H. P. surface condenser, a Knowles air and circulating pump, and a feed-water heater situated in the smoke flue. The station is built to allow the addition of one 1,000 H. P., and there is room for 9 additional boilers and another line of shafting. It has a capacity for 42 dynamos. At present there will be 14 in use, 11 arc and 2 alternating current machines, and generator for railway work; on the second floor are the store and testing rooms and the superintendent's office.

## Railway Statistics of Canada.

The following figures are taken from the annual report of A. P. BRADLEY, Sec. Dept. Railways and Canals, for the year ending June 30, 1888.

MILEAGE AND CHARACTERISTICS OF ROAD.

| | Miles. |
|---|---|
| Completed (rails laid) | 12,702 |
| Under construction | 540 |
| Steel rails (iron rails, 1,038 miles) | 11,664 |
| Sidings | 1,532 |
| | Number. |
| Grade crossings (guarded, 115; not guarded, 7,910) | 8,025 |
| Overhead bridges | 364 |
| Grade crossings of other railways | 147 |
| Junctions with other railways and branch lines | 398 |

ROLLING STOCK.

| | Owned. | Hired. |
|---|---|---|
| Locomotives | 1,618 | 39 |
| Sleeping and parlor cars | 71 | 8 |
| First-class passenger cars | 742 | 17 |
| Second-class and emigrant cars | 553 | 15 |
| Baggage, mail and express cars | 483 | 21 |
| Box and cattle cars | 24,918 | 2,952 |
| Platform and hopper cars | 15 897 | 242 |

OPERATIONS.

| | |
|---|---|
| Train mileage (passenger, 11,859,684; freight, 20,651,834; mixed, 4,763,318) | 37,301,206 |
| Engine mileage | 46,489,228 |
| Passengers carried | 11,416,791 |
| Tons freight handled | 17,172,759 |

EARNINGS.

| | |
|---|---|
| Passenger | $12,744,636 |
| Freight | 26,410,085 |
| Mails and express | 1,027,732 |
| Other sources | 1,976,699 |
| Total | 42,159,153 |

OPERATING EXPENSES, ETC.

| | |
|---|---|
| Maintenance of way, buildings, etc | $ 6,703,262 |
| Working and repairs of engines | 10,035,312 |
| " " " cars | 3,002,657 |
| General operating expenses | 10,516,496 |
| Total | 30,652,046 |
| Net earnings | 11,577,107 |
| Total capital | 727,180,449 |
| Capital furnished by Government and municipalities | 168,642,529 |

From the above it appears that the average capitalization per mile of Canadian railways is $57,258, and the net earnings were only sufficient to pay a little over 1½ per cent. on this capitalization.

FATAL ACCIDENTS.

| | Passengers Killed. | Employés Killed. | Others Killed. | Total. |
|---|---|---|---|---|
| Falling from cars or engines | 4 | 22 | 4 | 30 |
| Getting on or off trains in motion | 6 | 7 | 8 | 21 |
| At work making up trains | ..... | 5 | ..... | 5 |
| Coupling cars | ..... | 6 | ..... | 6 |
| Collisions and derailments | 8 | 28 | 3 | 39 |
| Walking or being on track | 2 | 24 | 84 | 110 |
| Explosions | ..... | 3 | 1 | 4 |
| Other causes | ..... | 12 | 4 | 15 |
| Total | 20 | 107 | 104 | 231 |

Besides this, 776 passengers and employés were injured. Of these injuries, 291 were due to coupling cars; collisions and derailments caused 113; and jumping on or off or falling from engines or cars caused 161.

## The Mammoth Canal Company, Wyoming.

One of the most important irrigation enterprises recently projected in Wyoming Territory is that of the Mammoth Canal Co. composed chiefly of Chicago capitalists. The headquarters of the company is at Green River, Wyo., the lands to be reclaimed being about 65 miles north of that place. The water supply is obtained from the Big Sandy river, the principal tributary of Green river, and capable of supplying several times the volume of water required by these lands.

The main canal is 35 ft. wide on the bottom, 45 ft. on the top, with a depth of 5 ft. and a grade of 2 ft. per mile. It has its head about 20 miles from the base of the Wind River mountains, and waters an extensive and fertile plateau between the Big and Little Sandy rivers.

Along the line of the canal is a natural depression which will be utilized for reservoir purposes: it has a superficial area of 2,000 acres and a depth of 25 ft., and can be utilized to water about 15,000 acres. As the only expense attached to its improvement for this purpose, is the excavation of an open cut or tunnel 400 ft. in length and the construction of the required discharge gates, it becomes a very valuable feature of the system, as it can be filled from the main canal during the non-irrigating season.

The area watered is about 50,000 acres; it is not only very fertile, but from its smooth surface and regular slope is admirably adapted to irrigation. In consequence of these favoring conditions, the entire cost of the works will not exceed $100,000.

The lands bordering the tributaries of Green river are among the most fertile and easily watered of any in the Territory, but owing to their distance from railroads or other communication, but little attention has been paid to them. The building of the Pacific Short Line through this section, which is now in progress, will however attract attention to its opportunities and make it a favorite field for irrigation enterprises during the next few years.

## Interlocking Switches and Signals.

Interlocking switches and signals were in practical use as long ago as 1847, says the Exhibition correspondent of *Engineering*. In the retrospective exhibition of means of transport is a model of an arrangement patented in 1847 and exhibited in 1851 at the great exhibition of that year. It is a signal post with two semaphore arms, painted red and white on opposite sides, and made to stand horizontally to show "line blocked" and in an inclined position to show "line clear." Each semaphore arm has a lever connected by a vertical rod to a counterweighted lever near the bottom of the post, and this joined to a wire under the control of the signalman. The counter weight is arranged to throw the arm up when the wire is slack, so that if any part of the apparatus fails to work the signal will be at "danger."

The interesting feature is that the signals were worked by stirrups instead of levers. There are four of these stirrups working in vertical guides and from the bottom of each depends vertically a round iron rod. Under each rod is a horizontal sliding plate, connected to one of the switch levers, and moving as the levers are thrown. In each of these plates is a round hole just large enough to admit the rod on the stirrup, so that it is evident that when any signal is lowered, the corresponding switch is locked and cannot be moved until the arm is again up and showing "danger." The general idea of interlocking switches and signals is here plainly shown, and a frame of this kind was actually set up and worked in the Copenhagen tunnel on the Great Northern Railway.

The interlocking by ratchet teeth dates from 1859, and an old model of this device is also shown there.

## CONTRACTING.

**Asphalt Paving.**—The Park Commissioners of New York City have awarded the contracts for asphalt paving in front of the City Hall to E. H. Wooton at $7,700, and for the walks in Tompkins Sq. to the Neuchatel Asphalt Co. at $15,840.

**Jail Work.**—At Portland, Ore., the following proposals have been received for the cells and iron work of the jail extension: Champion Iron Works, Kenton, O., $9,465; Willamette Iron Works, $13,300; Pauly Jail Building & Mfg. Co., St. Louis, $14,833.33; Diebold Safe & Lock Co., Cincinnati, O., $10,985; Smith & Watson Iron Works, $14,000; Mosier, Bechmaren & Co., $14,680; Van Dorn Iron Works, two bids, $10,000 and $11,000.

**Buildings.**—Contracts for the Court House and City Hall building at Minneapolis, Minn., have been awarded by Long & Kees, architects, of Minneapolis: Iron work: Cram Iron Co., of Minneapolis, at $23,570.59 for the cast-iron work, and $40,509.31 for the wrought-iron work, floor beams, channels, etc. Granite: Hagblin & Morse, of Minneapolis, at $251,339 for Ortonville granite.

The contract for granite for the new Congressional Library building at Washington, D. C., has been let to the New England Granite Co., of Hartford, Conn., at about $1,300,000.

**Dredging.**—The following contracts for dredging in the Hudson river have been awarded by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. At Parda Hook, 7,000 cu. yds., to P. J. Brumelcamp, of Syracuse, at 13¼ cts. per cu. yd.; at Mulls Light, 18,000 cu. yds., to E. M. Payn, of Albany, at 12.9 cts. per cu. yd.; at New Baltimore, 11,000 cu. yds., to M. Myers, at 13 cts. per cu. yd., and 5,000 cu. yds., to P. J. Brumelcamp, at 25 cts.

**Jail.**—The contract for the new county jail at Thomasville, Ga., has been awarded to the Pauly Jail & Mfg. Co., of St. Louis, Mo., at $11,200. The building will be two stories high, built of Macon pressed brick and having water, gas, and sewer connections. It will accommodate 30 prisoners, 24 of whom may be confined in steel cells or cages.

**Dike.**—The contract for the construction of a dyke at Saugerties, N. Y., has been awarded by Lieut.-Col. G. L. GILLESPIE, U. S. Engineer Office, New York, to Wm. Parrot, of Newburg, N. Y.

**Court House.**—The contract for the completion of the Brown County Court House at New Ulm, Minn., has been awarded to Schapakam Bros., & Co., of New Ulm, at $12,855. Work is to be completed by Sept. 15.

**Street Work.**—*Brooklyn, N. Y.*—The following proposals have been received by the Commissioner of City Works for grading and paving a part of Evergreen Ave.: Dennis Norton, $4.93 per lin. ft.; Wm. Mogk, $5.47; Wm. Weis, $5.97; John S. Bogart, $6.75.

*Fort Smith, Ark.*—The following proposals have been received by the Paving Commissioners: Kenyon & Enright, Kansas City, Mo.: $1.87 per sq. yd. for brick paving, 75 cts. per lin. ft. for new curbing, 20 cts. per lin. ft. for relaying old curbing; W. A. Doyle, Kalamazoo, $1.86, 76 cts., 15 cts.; John Mahony, Kansas City, $2.04, 73 cts., 10 cts.; Ela, Harding & Co., $2.07, 85 cts., 20 cts.; Thornton & Co., Clinton, Mo., $2.24, 95 cts., 30 cts. The contract was awarded to W. A. Doyle, who built the sewerage system. There are about 44,000 sq. yds. of work, and the total cost will be $80,000 for paving and $6,000 for curbing; 20,000 sq. yds. are to be finished by January. The contractor will manufacture the brick, as the contract calls for home brick; the curbing will be supplied by E. McKenna.

*Topeka, Kan.*—The mayor has vetoed the award of a contract to Mulvane & Ramsey for brick paving Van Buren St. at $2.11 per sq. yd., and 75 cts. per lin. ft. for Colorado sandstone curbing. The reason given is that lower bids had been received.

*Allegheny, Pa.*—Asphalt block pavement is to be laid on Federal St.

**Race Course.**—W. E. Warren, of Oceanport, N. J., has the contract for the new Monmouth Park race course.

**Asphalt Paving.**—*Albany, N. Y.*—The following proposals have been received by the Board of Contract and Apportionment. The work on Delaware Ave, includes 22,100 sq. yds. of asphalt, 10,480 lin. ft. of new curb, 606 lin. ft. of sidewalk relaid, 168 lin. ft. of circular curb, 8,100 cu. yds. filling, 10,900 cu. yds. excavation, 9,623 lin. ft. of new sidewalk. The work on Pine Ave. includes 4,855 sq. yds. of asphalt, 2,778 lin. ft. of flagging, sod, trees, sidewalks, etc., 2,804 lin. ft. of new curb, 36 lin. ft. of circular curb, 34,300 cu. yds. of excavation, 13,600 cu. yds. filling, soiling, and sodding. Both contracts were awarded to the National Vulcanite Co., of Jersey City, N. J., the approximate cost of the work under both contracts being $110,655. The other bidders were the Barber Asphalt Paving Co., of New York, and the Warren-Scharf Asphalt Paving Co., of New York.

*Delaware Ave.*

| Bidders. | Asphalt per sq. ft. | Curb per lin. ft. | Relay Sidewalk per ft. | Circular Curb per lin. ft. | Filling per cu. yd. | Excav'tn per cu. yd. | New Sidewalk per lin. ft. |
|---|---|---|---|---|---|---|---|
| | $ | cts. | cts. | cts. | cts. | cts. | $ |
| B. A. Pav. Co. | 3.00 | 95 | 50 | 95 | 75 | 35 | 1.10 |
| Nation. Vul. Co. | 2.65 | 70 | 20 | 75 | 10 | 30 | 1.15 |
| W.-S Paving Co. | 3.20 | 60 | 55 | 75 | 16 | 36 | 1.20 |

*Pine Ave.*

| Bidders | Aephalt per sq. yd. | Curb per lin. ft. | New Sidewalk per lin. ft. | Circular Curb per lin. ft. | Excavation per cu. yd. | Filling per cu. yd. |
|---|---|---|---|---|---|---|
| | $ | cts. | $ | cts. | cts. | cts. |
| B. A. Pav. Co. | 3.00 | 45 | 1.74 | 05 | 35 | 15 |
| Nation. Vul. Co. | 2.60 | 70 | 1.30 | 75 | 30 | 19 |
| W.-S. Pav. Co. | 3.00 | 60 | 1.80 | 75 | 37 | 17 |

**Roads.**—The Commissioners of Randolph County, Ind., have let the contracts for the construction of three more gravel roads, to be known as the Weimer, Hensbey and Goodrich free gravel roads. The total cost of construction will be $10,116, and the total length of the roads 7½ miles. This will make a total of free gravel roads in Randolph county of 195 miles.

**Sewers.**—*Raleigh, N. C.*—The following proposals for the construction of the new sewers were received July 15 by the Sewerage Committee, and the contract was awarded to Quinn & Smith, of Nashville, Tenn. C. G. LATTA is Chairman of the Committee, and J. L. LUDLOW is the Engineer. The bids for pipe laying include Ys, branches, and detachable covers, with cement joints.

| ITEMS. | | Quinn & Smith, Nashville, Tenn. | | Kelly & Loughran, Ashville, N. C. | | P. Linehan, Raleigh, N. C. | | Irwin & Maher, Greenville, O. | | John Jacoby, Bridgeport, Ct. | | J. H. Winder, Raleigh, N. C. | | Clements Bros., Cleveland, O. | | C. S. Ferrall, Raleigh, N. C. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Estm'd Quan. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price. | Estima'd Cost. | Price | Estima'd Cost |
| *Price per lin. ft. for* | | cts. | | cts. | | cts. | | cts. | | cts. | | cts. | | cts. | | cts | |
| Laying 6-in. pipe | 28,410 | .03½ | $994.35 | .04 | $1,136.40 | .05 | $1,420.50 | .03 | $852.30 | .04 | $1,136.40 | .07 | $1,988.70 | .05 | $1,420.50 | ..... | ..... |
| Laying 8 in. pipe | 54,700 | .03⅝ | 1,969.20 | .05½ | 3,008.50 | .05½ | 3,008.50 | .03 | 1,641.00 | .05 | 2,735.00 | .08 | 4,376.00 | .05½ | 3,008.50 | ..... | ..... |
| Laying 10-in. pipe | 8,500 | .03⅞ | 314.50 | .06½ | 552.50 | .06 | 510.00 | .04 | 340.00 | .06 | 510.00 | .10 | 850.00 | .06⅛ | 525.50 | ..... | ..... |
| Laying 12-in. pipe | 14,800 | .03⅞ | 562.40 | .07 | 1,036.00 | .06½ | 962.00 | .04 | 592.00 | .07 | 1,036.00 | .13 | 1,924.00 | .07½ | 1,110.00 | ..... | ..... |
| Laying 15-in. pipe | 5,800 | .04 | 232.00 | .08 | 464.00 | .07 | 406.00 | .05 | 290.00 | .09 | 522.00 | .17 | 986.00 | .09 | 522.00 | ..... | ..... |
| Laying 18-in. pipe | 500 | .04¼ | 21.25 | .09 | 45.00 | .08 | 40.00 | .05 | 25.00 | .10 | 50.00 | .20 | 100.00 | .11 | 55.00 | ..... | ..... |
| Excavation and back filling up to 6 ft. per lin ft | 20,500 | .16⅓ | 3,295.77 | .14 | 2,870.00 | .12 | 2,460.00 | .20 | 4,100.00 | .12 | 1,460.00 | .27 | 5,535.00 | .30 | 615.00 | .19 | 3,895.00 |
| Excavation and back filling, 6 to 8 ft. | 60,610 | .17⅞ | 10,707.76 | .18 | 10,909.80 | .15 | 9,091.00 | .25 | 15,152.50 | .18 | 10,909.80 | .35 | 21,213 50 | .40 | 24,244.00 | .29 | 17,576.90 |
| Excavation and back filling, 8 to 10 ft. | 20,400 | .26 | 5,304.00 | .20 | 4,080 00 | .19 | 3,876.00 | .39 | 7,956.00 | .25 | 5,100.00 | .58 | 11,832.00 | .64 | 13,056.00 | .47 | 9,588.00 |
| Excavation and back filling, 10 to 12 ft. | 6,400 | .35 | 2,240.00 | .24 | 1,536 00 | .38 | 2,432.00 | .55 | 3,520.00 | .35 | 2,240.00 | .70 | 4,480.00 | .90 | 5,760.00 | .54 | 3,456.00 |
| Excavation and back filling 12 to 14 ft | 1,500 | .50 | 750.00 | .30 | 450.00 | .51 | 765.00 | .80 | 1,200.00 | .45 | 675.00 | .90 | 1,350.00 | 1.20 | 1,800.00 | 62 | 930.00 |
| Excavation and back filling, 14 to 16 ft. | 700 | .70 | 490.00 | .40 | 280.00 | .64 | 448.00 | 1.25 | 875.00 | .55 | 385.00 | 1.05 | 735.00 | 1.60 | 1,120.00 | .80 | 560.00 |
| Excavation and back filling, 16 to 18 ft. | 1,500 | .92 | 1,380.00 | .60 | 900.00 | .85 | 1,275.00 | 1.45 | 2,175.00 | .60 | 900.00 | 1.20 | 1,800.00 | 1.90 | 2,850.00 | .95 | 1,425.00 |
| Excavation and back filling, 18 to 20 ft. | 950 | 1.00 | 950.00 | .80 | 760.00 | 1.00 | 950.00 | 1.90 | 1,805.00 | .90 | 855.00 | 1.40 | 1,330.00 | 2.10 | 1,995 00 | 1.13 | 1,073.50 |
| Rock trench per ft, in depth | ..... | .22½ | 225.00 | .34⅜ | 345.00 | .20 | 200.00 | .55 | 550.00 | .20 | 200.00 | 1.75 | 1,750.00 | .40 | 400.00 | 40 | 400.00 |
| Restoring street } Block pave't. | 900 | .55 | 495 00 | .12 | 108.00 | .06 | 54.00 | .09 | 81.00 | .10 | 90.00 | .08 | 72.00 | .24 | 216.00 | .05 | 45.00 |
| surface over pipe } Ordinary, line | 90,000 | .00¼ | 225.00 | .00⅓ | 450.00 | .02 | 1,800.00 | .01 | 900.00 | .01 | 900.00 | .02 | 1,800.00 | .20 | 18,000.00 | ..... | ..... |
| Laying brick with cement mortar per 1,000, in man-holes, lamp-holes, flush tanks, etc.. | 350,000 | $5. | 1,750.00 | $9. | 3,150.00 | $8. | 2,800.00 | $4.50 | 1,575.00 | $7. | 2,450.00 | $5. | 1,750.00 | $13.50 | 4,725 00 | $4. | 1,400.00 |
| Iron pipe laid, with lead joints complete, per ton | 5 | $38. | 190.00 | $45. | 225.00 | $45. | 225.00 | $45.00 | 225.00 | $40. | 200.00 | $35. | 175.00 | $83.00 | 415.00 | ..... | ..... |
| Embankment per cu. yd. | 200 | .15 | 30 00 | .20 | 40.00 | .18 | 36.00 | .90 | 180.00 | .20 | 40.00 | .20 | 40.00 | .40 | 80.00 | .50 | 100.00 |
| Total | ..... | ..... | $32,126.23 | ..... | $32,340 20 | ..... | $32,759.50 | ..... | $44,034.80 | ..... | $33,394.20 | ..... | $64,087.20 | ..... | $81,917.50 | ..... | $40,449.40 |

## PROPOSALS OPEN.

**Bridges.**—Iron truss bridge, 100 ft. long, 24 ft. roadway, 6 ft. sidewalk, over Cahokia creek; wooden bridge 165 ft. long; viaduct over railway tracks on Broadway. M. STEPHENS, Mayor, East St. Louis, Ill.

Wrought iron or steel bridge across Acushnet river at Fairhaven; 450 ft. long, 32 ft. roadway, 6 ft. sidewalk each side. Draw with 2 openings of 40 ft. operated by hand. THE COUNTY COMMISSIONERS, New Bedford, Mass. August 1.

Bridge at Cedar Ave.; $60,000 appropriated. A. E. SMYRK, City Commissioner, Baltimore, Md. August 5.

Over Schooner river. J. L. ESKRIDGE, Coffeeville, Miss. August 5.

Substructure and iron superstructure of a bridge over Rocky river. Plans and specifications on file. THE COUNTY COMMISSIONERS, Cleveland, O. August 7.

Across Cowlitz river. Combination Pratt truss of 135-ft. span. DAVID URQUHART, County Auditor, Chehalis, Wash. Ty. August 7.

Bridge 125 ft. span on iron piers filled with concrete. The COUNTY SUPERVISORS, Tehama, Cal. August 7.

Across Little Sioux river; iron or wood substructure and superstructure, 120 ft. main span, 16 ft. roadway; 35 ft. approaches, 38 ft. piling for main span. A. L. WILKINSON, Board of County Supervisors, Danbury, Ia. August 8.

Wooden bridge; 1 span of 68 ft. J. M. STONE, Marietta, Ga. August 10.

Across Santa Yuez river near Lompoc; 1 span of 180 ft., 50 ft. approaches; floor 22 ft. above low water. F. L. KELLOGG, Clerk of County Supervisors, Santa Barbara, Cal. August 12.

**Street Work.**—Regulating and granite block paving. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. July 31.

Grading, paving and curbing on Van Voast Ave. THE BOARD OF TRUSTEES, care CHAS. L. HARRISON, Town Clerk, Bellevue, Ky. August 1.

Trinidad asphalt paving, curbing, etc.; 15, 18 and 20-in. extra heavy vitrified pipe and Ys, 6-in. connections, manholes, basins, etc. THOMAS J. LANAHAN, Clerk of Board of Contract, Albany, N. Y. August 5.

Grading, draining and improving Lake Ave. J. C. MOORE, Village Clerk, Ashtabula, O. August 17.

**Brick Paving.**—About 8,000 yds. of vitrified fire-clay brick paving. T. B. BEIL, Secretary of the Borough, Sharon, Pa. July 31.

**Building.**—Soldiers' Home. THE BOARD OF COMMISSIONERS, Hot Springs, Dak. August 7.

**Diving Dresses.**—Two dresses, for work on the St. Mary's river. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. August 10.

**Well.**—Digging an 8-in. well for water supply. The MAYOR, Emmettsburg, Ia. July 31.

**Dredging.**—At piers 44, 45, 46, North river; 17,000, 26,000, 14,000 cu. yds. The DOCKS COMMISSIONERS, Pier A, North river, New York City. August 1.

**County Building.**—Building, 24 x 44 ft.; vault, 12 x 20 ft. Plans and specifications on file. H. P. BLALOCK, Clerk of Commissioners of Roads and Revenues, Greenville, Ga. August 6.

**Reservoir.**—Improvements to distributing reservoir at St. Johnland, L. I. JAS. F. CAREY, Engineer. E. B. CADLEY, Clerk of Supervisors, County Court House, Brooklyn, N. Y. August 6.

**Electric Light.**—Putting in 100 incandescent lamps for street lighting. The CITY CLERK, Pana, Ill. August 10.

**River Improvement.**—Wing dams and shore protection in the Savannah river below Augusta. Lieut. O. M. CARTER, U. S. Engineer Office, Savannah, Ga. August 15.

**Prison Iron Work.**—For reformatory. Architect, J. G. HASKELL, Topeka, Kan. J. S. MCDOWELL, Chairman of Board of Industrial Reformatory Commissioners, Hutchinson, Kan. August 15.

**Court House and Jail.**—Plans and bids; cost not to exceed $185,000. W. R. FORREST, County Clerk, Seattle, W. T. September 2.

**Sewers.**—About 4,742 ft. of 15-in. pipe, 8,205 ft. of 12-in., 3,169 ft. of 10-in., 65,119 ft. of 8-in.; 32,314,91 and 4,384 Y branches; 190 manholes. THE BOARD OF PUBLIC WORKS, Denver, Col.

## MANUFACTURING AND TECHNICAL.

**Steel Ingots.**—A Boulton plant for making steel ingots, manufactured by the Solid Ingot Co., of Newark, N. J., is being put in by Singer, Nimick & Co., of Pittsburg, Pa.

**Cable Grips.**—The Vold Cable Crossing Grip & Car-Brake Co., of East St. Louis, Ill., has increased its capital stock to $500,000.

**Car Wheels.**—The Steel Truss Car Wheel Co., of Edwardsville, Ill., has been incorporated by JACOB DARNSTEDTER, E. B. GLASS, J. S. TRAVES and others, to manufacture car wheels under the Darnstedter patents.

**Pavements.**—The Western Paving & Supply Co., of Chicago, Ill., has purchased the plant of the Indianapolis Paving Co. and will contract for asphalt, wooden, granite or other pavements.—The Helena Concrete Co., of Helena, Mont., a branch of a company at Elgin, Ill., has been organized to lay concrete sidewalks.

**The Deming Construction Co.** has been licensed by the Secretary of State to incorporate in Chicago for the construction of railways in Mexico. Capital stock $50,000. Incorporators, GEORGE M. HUSS, G. L. MOREHOUSE and S. T. B. JACKSON.

**Pipe Works.**—The Shickle, Harrison & Howard Iron Co., of St. Louis, Mo., has established a branch plant at East St. Louis, Ill., under the charge of Mr. CHAS. L. HARTSPELL, Superintendent.

**The Ogden Artesian Well Co.**, of Ogden, Utah, has plant for drilling wells 6 to 10 ins. diameter to a depth of 2,500 ft. in any formation.

**Gauges.**—The Reliance Gauge Co., of Cleveland, O., has received, through the Variety Iron Works, another order for 5 of the Reliance safety water columns, from the Brooklyn Street Railway Co., for the boilers which are being added to the electric motor plant. Second and third orders have also been received, through the Laidlaw & Dunn Co., from breweries in Cincinnati.

**Tie Plates and Car Doors.**—The Dunham Mfg. Co., of Boston, Mass., has received orders from the Northern Pacific R. R. for Servis tie-plates and 1,500 sets of the Dunham storm-proof doors for freight cars. Also an order for 500 sets of doors from the Missouri Pacific R. R., and a number of smaller orders from other roads. The Rio Grande Western R. R. has ordered 20,000 of the tie-plates, or enough for 40 miles of track, for the State line extension.

**Nails.**—Carnegie, Phipps & Co., of Pittsburg, Pa., have issued a card of prices of various kinds of nails, as adopted on July 15.

**Valves and Hydrants.**—The Stillwell Mfg. Co., of Philadelphia, Pa., has the right for the exclusive manufacture of the Viney improved stop valve, of which 500 are in use in Philadelphia and 100 in Washington. Superior efficiency, durability, and economy are claimed for these valves; when used at four-way intersections, they dispense with the use of from 3 to 5 ordinary two-way valves, and they also dispense with the use of a single branch for fire hydrants at any point. They are not liable to be clogged by sediment, as any deposit in the bottom of the valve bodies does not interfere with the action of the valves. The plugs carrying the movable valve faces are hollow, and thus allow any sediment remaining below the diameter of the valve face, which is all that can remain in the two or four-way valves, to pass up into the hollow of the plug. In the three and five-way valves, all the sediment is instantly discharged on flushing the hydrant. The face-plate is of brass, with a white metal seat. For sizes from 20 to 48 ins. diameter, a swing gate valve is made, operated by gearing. The company also manufactures the Kevstone non-freezing hydrant, in which the working parts are removable for repairs without digging down to the base, and the ball valve is entirely out of the water-way when open.

**Resources of the South.**—The *Manufacturers' Record*, of Baltimore, has organized an exploring party to investigate and report upon the mineral districts and other resources of the South. The party will be under the management of Major G. B. WEST, of Birmingham, Ala., who will be accompanied by an engineer, geologist, timber expert, etc. They will be in the field for 6 or 8 months.

**Coal Consumption by Locomotives.**—The Delaware & Hudson Canal Co. is weighing coal on the engines to determine as to the relative amounts used by Engine 210, which has the extension front, with straight smokestack, and Engine 117, of the old pattern.

**Rail Joints.**—The Walsh Rail-Joint Co. has been incorporated at Troy, N. Y., by ERASTUS H. VAUGHN, JOHN W. WALSH and EDWARD F. MURRAY. The capital stock is $25,000, and the company will manufacture railway joints and other railroad supplies.

**Car Couplers.**—The Layman Safety Car Coupler Co., of Little Rock, Ark., proposes to establish works at Memphis, Tenn.

**Gas.**—The Illuminating & Fuel Gas Co., using the Brooks process, has established offices in the Drexel building, Philadelphia. President, W. A. LEAVITT; Engineer, GEO. R. WAITE.

**The Reading Iron Works**, which failed some time ago, have been sold to W. P. BARD, of Reading, for $150,500, subject to a mortgage of $600,000. The purchase is for the Philadelphia & Reading R. R.

**Filters.**—The Rapid Safety Filter Co. has been incorporated at San Francisco, Cal., by C. J. ACKERMAN, T. J. CRAIG, MOSES DEUTCH, H. S. HUNT, and WALTER D. MANSFIELD. Capital stock, $500,000.

**Fences.**—The Western Hedge Fence Co. has been organized at Dardanelle, Ark. President, W. H. GEE; Vice-President, G. L. KIMBALL; Secretary, B. H. MERRIOTT. Capital stock, $60,000.

**The Lidgerwood Mfg. Co.** has enlarged its principal office at 96 Liberty St., New York, which will enable it to handle more readily the large and growing business in hoisting machinery and appliances. The company has opened a new branch in Boston, at Nos. 197 to 203 Congress St., which will be in charge of Mr. J. H. HOUGHTON, who will also represent the Gorton & Lidgerwood Co., makers of the Gorton house-heating steam boiler. Mr. MOSES P. JOHNSON, 717 North 2d St., St. Louis, Mo., is the Lidgerwood Mfg. Co.'s new representative in that city.

**The Ball Engine Co.**, of Erie, Pa., manufacturers of the Ball automatic cut-off high speed engine, is making considerable extensions to its plant and buildings in order to increase its capacity to meet orders. Orders are on hand for 7,165 H. P. of engines for electric light and railway plants; the first of twelve 300 H. P. compound engines for the Edison Electric Illuminating Co., of Brooklyn, N. Y., has been completed. The company is now bringing out a line of compound engines, both tandem and double horizontal engines, of 30 to 300 H. P.

**Catalogue.**—The Kilbourne & Jacobs Mfg. Co., of Columbus, O., has issued a new illustrated circular of their manufactures, including drag and wheel road scrapers, railway and grading plows, steel tubular mining and foundry barrows, and bolted barrows of all kinds; wrought steel sinks, railway, farm and plantation dump carts, hand push cars and carts. Earth-moving implements and pressed steel shapes are a specialty.

**The Otis Iron & Steel Co.**, of Cleveland, O., has sold its plant to an English syndicate for $4,500,000. The company employs about 1,000 men and manufactures boiler plate, ship plate, etc. The works will be carried on under the old management for the present.

**Car Heating.**—The Consolidated Car Heating Co. has been organized at Albany, N. Y., by the consolidation of the McElroy Car Heating Co., of Detroit, Mich., and the Sewall Car Heating Co., of Portland, Me. President, ROBT. C. PRUYN, Albany; Vice-President, A. S. HATCH, New York; Second Vice-President and Treasurer, WM. G. RICE, Albany; Secretary, CHAS. G. PEABODY, Albany; Mechanical Superintendent, J. F. MCELROY, Albany. The directors are, ROBERT C. PRUYN, Albany; A. S. HATCH, New York; A. N. BRADY, Albany; GEORGE N. GRAY, Chicago; GEORGE L. WALKER, Detroit; D. D. SEWALL, Portland, Me.; J. F. MCELROY, Albany; GEORGE BURNHAM, JR., Portland; WM. G. RICE, Albany; J. H. SEWALL, Portland; R. C. BLACKALL, Albany; ALBION LITTLE, Portland; CHARLES G. PEABODY, Albany; H. S. OSGOOD, Portland; E. O. ROESSLE, Albany.

**Tobin Bronze**, manufactured by the Ansonia Brass & Copper Co., of New York, is being largely used for air-pump linings, pump rods, bolts, etc. It has also been tried by railway companies for car journal bearings, and has given good results for this service.

**Locomotives.**—The Rhode Island Locomotive Works, of Providence, R. I., have sold 5 engines to the Chattahoochee Brick Co., of Atlanta, Ga., for the Columbus Southern road.

The Baldwin Locomotive Works, of Philadelphia, Pa., are building several engines for the Pennsylvania road.

**Cars.**—The Gilbert Car Co., of Troy, N. Y., is building two cars for the Troy & Lansingburg electric road.

The Ohio Valley Car Co., of Jeffersonville, Ky., has an order for 250 box cars for the East Tennessee, Virginia, & Georgia road.

The St. Louis Car Co., of St. Louis, Mo., is building 15 street cars for St. Joseph, Mo., and 15 for Peoria, Ill.

The Laclede Car Co., of St. Louis, Mo., is building 40 grip cars and 40 passenger cars for the Denver City Cable Ry. Co.

**Machinery Wanted.**—Bolt forging machines are wanted by W. C. Ellis & Sons, Memphis, Tenn.

A 2 H. P. Shipman engine is wanted by the Rochester Cycle Mfg. Co., 22 South Water St., Rochester, N. Y.

A second-hand vertical engine of 4 to 8 H. P. Address P. O. Box 144, Troy, Ill.

A second-hand 4 H. P. engine and 6 H. P. boiler, are wanted by E. R. Stengland, Marathon, Ia.

**The International Mfg. Association** has been organized to encourage the inventors of mechanical devices, to investigate the value of, and to direct the development of good inventions. President, EDMUND C. STANTON; Consulting Engineer, BENJAMIN S. CHURCH. The association is also negotiating for the U. S. agency for foreign companies of a similar character, so as to facilitate the patenting and development of foreign inventions in this country and home inventions abroad. The office is at 10 Wall St., New York.

## BRIDGES AND CANALS.

**Bridge Notes.**—*Erving, Mass.*—Dean & Westbrook, of New York, have the contract for an iron bridge. P. J. Flemming of Greenfield, has the contract for masonry, and Samuel Holmes the contract for roadway of approaches.

*Brooklyn, N. Y.*—The contract for the Grand St. bridge and approaches at Newtown creek has been awarded to Charles A. Cregin at $65,000. The other bidders were Dean & Westbrook, Smith Bridge Co., and King Iron Bridge & Mfg. Co. The bridge will be 120-ft. span. The estimate of the engineer JOHN J. MCLAUGHLIN, was $60,000, exclusive of approaches.

*Cohoes, N. Y.*—An appropriation of $1,500 has been

made by the State for completing the Ship St. bridge over the Champlain canal.

*Rome, N. Y.*—The State has authorized the Superintendent of Public Works to construct a new iron bridge with double driveways and sidewalks, to replace the old structure over the Erie canal at George St. Plans are to be prepared by the State Engineer. The appropriation is $5,000.

*Allegheny, Pa.*—The Rapid Transit Ry. Co. has applied for a charter for a bridge over the Allegheny river from Craig St., Allegheny, to 4th St., Pittsburg.

*Ellicott City, Md.*—The County Commissioners of Howard and Prince George's counties have awarded the contract for a bridge over the Patuxent river to Cofrode & Saylor, of Pottstown, Pa., at $5,170.

*Ashland, Va.*—Contracts have been awarded to the following bidders for the rebuilding of the bridges washed away by the late freshets: Newman's bridge, to John Pollard, for $600; Little Pages, to L. F. Blanton, $450; Thomas' Mill, over Chickahominy river, to Mr. Francis, for $330; French Hay, to Mr. Hazelgrove, for $70; Blunt's and Horseshoe, to C. H. Oliver, for $150 and $425; Ground Squirrel to Henly & Harlow for $200.

*Knoxville, Tenn.*—The Knoxville Southern Ry. Co. will build an iron bridge, on masonry abutments, over the Tennessee river, at a cost of $200,000.

*Leaksville, N. C.*—The following proposals have been received by C. S. HAMLIN: King Iron Bridge & Mfg. Co., Cleveland, O., $5,040 (accepted); Groton Bridge Co.: Groton, N. Y., $5,114; Geo. H. Crafts, Atlanta, Ga., $5,529; Canton Bridge Co., Canton, O., $3,716 for superstructure; Columbus Bridge Co., Columbus, O., $5,693; M. Converse, $5,104.

*Canton, Ga.*—The contract for the county bridge over the Etowah river has been awarded to the Columbus Bridge Co., of Columbus, O., at $4,490 for a 3 span Pratt truss iron bridge.

*Cincinnati, O.*—The County Engineer is preparing plans for a bridge over Muddy Creek at Addyston, and a bridge on Section Ave. Two bridges are to be built over Duck Creek.

*St. Cloud, Minn.*—Blake Bros., of New York, have taken the $80,000 of bridge bonds.

*Minneapolis, Minn.*—The County Commissioners have awarded the contract for the substructure of the Bloomington Ave. ferry bridge to W. D. Van Norman, his bid being $1,438. The bid of Morris & Foley was $1,765. Several bids were rejected, the legal requirements not having been complied with. The following bids for the superstructure were received: George E. King Bridge Co., $10,800; Pittsburg Bridge Co., $10,500; S. M. Hewitt, $11,500; Wisconsin Bridge Co., $8,942; Minneapolis Bridge Co., $9,489; Horace E. Horton, $9,995; King Iron Bridge & Mfg. Co., $10,895; Milwaukee Bridge & Iron Works, $10,350; Wrought Iron Bridge Co., $11,300; A. Y. Bayne & Co., $10,000.

The Board instructed the engineer to employ Ferris & Co., of Pittsburg, to inspect the iron used in the Minnesota river bridges. The engineer of the Bloomington bridge was also directed to have a man look after the inspection of the stonework in that bridge.

*St. Charles, Mo.*—Ackley Bros. will rebuild the Taylor creek bridge, the fall of which was noted last week, and will give bonds to keep it in repair.

*Albina, Ore.*—A trestle is to be built across the Montgomery slough at Goldsmith St. It will be 480 ft. in length and will have 23 bents 20 ft. apart. The bridge will be 36 ft. high and level with the grade. The width will be 60 ft., with two car tracks, two sidewalks for foot passengers, and ample room for teams. It will cost about $5,000 and will be built jointly by the city and the Electric Railway Co.

*Fort Worth, Tex.*—The County Commissioners have awarded the contract for an iron bridge at Dagget crossing to the King Iron Bridge & Mfg. Co., of Cleveland, O., at $4,769.

*San Angelo, Tex.*—The Milwaukee Bridge & Iron Co. has the contract for 9 iron bridges in Bell county for $65,000.

Canals. *Chesapeake & Ohio.*—Becker & Blundon, the contractors for repairing the Georgetown level, are pushing the work rapidly, and expect to complete it in the contract time of 31 days.

*Shinnecock.*—Captain Scott, of New London, Conn. has contracted with the State of New York for $25,000 to pump out the canal and wall it on both sides.

## ELECTRICAL.

Electric Lighting.—*Springfield, Mass.*—The committee on Street Lighting has awarded a contract to the Marr Construction Company, of Boston, for 300 electric-light poles. The contract calls for poles of hard Georgia pine, to be set 6 ft. in the ground, and the part in the ground to be covered with a mixture of coal-tar and pitch. Of these 300 poles, 150 are to be 25 ft. long, 100 to be 30 ft. long, and 50 to be 35 ft. long. The work of placing them is to be completed on or before October 1. The cost of the poles erected is: For the 25-ft. poles, $10 each; for the 30-ft. poles, $14 each; for the 35-ft. poles, $15.50 each. This makes the cost of the whole $3,675. The poles are to be equipped with steps of a design approved by the committee and also with a cross iron at the top.

*Skaneateles, N. Y.*—The Central New York Electric Light & Power Co. has been organized by ALEX. VAN VLECK, R. B. WHEELER, and GEO. BARROW, with a capital stock of $100,000.

*Gloversville, N. Y.*—The Thomson-Houston Electric Light Co. has applied for an exclusive franchise.

*Baltimore, Md.*—Judge DENNIS has granted the injunction asked by H. IRVINE KEYSER and others against the mayor and city council of Baltimore and the Brush Electric Co. The complainants number 100 taxpayers of Baltimore, and they asked an injunction to restrain the carrying out of the contract for lighting the city made with the Brush Co., and also to prohibit the payment of any money for such purpose. The contract went into effect on July 1, and it is stated that the Brush Co. has no claim upon the city for furnishing electric lights since that date, as notice was served upon them previous to July 1 that the contract would be contested. It is probable, however that the case will be appealed.

*Wytheville, Va.*—The Wytheville Electric Power & Improvement Co. has contracted with the Thomson-Houston Co., for an arc and incandescent plant.

*Savannah, Ga.*—The Mutual Electric Light Co. has been organized by H. BLUM, D. DOUGLASS and B. A DENMARK, of Savannah, and RANDALL MORGAN, S. T. BODINE and A. C. HUMPHREYS, of Philadelphia. Capital stock, $50,000.

*Vicksburg, Miss.*—The Hill City Electric Light Co. proposes to put in an incandescent plant for domestic lighting.

*Ravenna, O.*—A contract will soon be let for an electric light plant. Address the City Clerk.

*Superior, Wis.*—The Superior Arc Light & Power Co. has been incorporated by A. W. STOW, W. B. KELLOGG, W. C. BROOKS, and others, and has a contract with the city. Capital stock, $50,000.

*Anoka, Minn.*—G. T. SYKES, of Minneapolis, has a contract for 14 arc lights of 2,000 c. p. and 40 incandescent lights of 50 c. p.

*Fort Madison, Ia.*—The Fort Madison Light Co. has been incorporated by DUDLEY BETTS and JAMES WATSON of New York, CHARLES SKEHAN, W. S. COLE, J. M. DONOVAN, JOHN F. FOLEY, and EUGENE A. DIKE, of Brooklyn; HUGH M. GILLIGAN, of Plainfield, N. J., and WILLIAM WHEELER, of Bogota, N. J. Capital stock, $300,000.

*Nebraska City, Neb.*—The water company is thinking of adding an incandescent plant to its electric light system.

*Seattle, W. T.*—The Seattle Electric Light Co. has a contract for street lighting and is getting its new plant in position.

*Corpus Christi, Tex.*—It is proposed to establish an electric light plant.

*Merida Yucatan.*—D. MIGUEL and A. B. SMITH have been in Cleveland, O., recently negotiating for a $300,000 electric light plant for this Mexican city.

## SEWERAGE AND MUNICIPAL.

Sewers.—*Marlboro, Mass.* A sewerage system will be put in next year.

*Sing Sing, N. Y.*—The Village Trustees will have a trunk sewer built through Main St.

*Poughkeepsie, N. Y.*—The contract for laying 1,500 ft. of Akron sewer pipe has been let to Mr. Caire.

*Goshen, N. Y.*—Plans for a sewerage system have been prepared by C. C. BROWN, Prof. of Engineering Department at Union College, Schenectady. An appropriation of $42,000 has been voted for the purpose, for which amount bonds will be issued payable in sums of $1,000 annually, to be disposed of by sealed bids. About 27,000 ft. of pipe will be laid. The specifications will be ready and open for bids within a few days. HARRISON W. NANNEY, President of the Village, can furnish any information desired.

*Portchester, N. Y.*—The Village Trustees have voted to construct the Grace Church St. sewer district. In accordance with the plans presented by JOSEPH B. RIDER, C. E., of Wm. B. Rider & Sons, South Norwalk, Conn. The estimated cost is $29,600.

*Braddock, Pa.*—It has been voted to issue $63,579 for the purpose of building a system of sewers for the borough.

*Tuscaloosa, Ala.*—The contracts for the sewer system have been awarded to J. B. Neely and G. L. Gillespie, of Chattanooga, Tenn.

*Cleveland, O.*—The council has passed a number of ordinances providing for sewers and street work.

*Cincinnati, O.*—The Lick Run sewer will be surveyed and contracts let this season. The construction will be of brick, size 20 ft. by 18 ft. for a distance of 3,700 ft.; 18 ft. by 16 ft. for a distance of 1,300 ft. to South Branch, one of the largest tributaries; from this point to the west corporation line, a distance of 4,800 ft., the size will be 14 to 12 ft. diameter. The cost will be $350,000. The plans have been prepared by the City Engineer.

*Madison, Wis.*—The city surveyor has been instructed to make a general investigation of the sewerage system of the city, having the sewers flushed from the city hydrants wherever necessary; and upon the completion of the examination make a report of the condition of the sewerage system; also any alterations, improvements or other work needed to be done to put and maintain the system in thorough repair and good working order.

*Kansas City, Mo.*—The City Engineer has prepared plans for extending one of the sewers 385 ft. It will be 32 ins. by 48 ins., on pile foundation, and will cost $20 per lin. ft.

*Little Rock, Ark.*—Sewer district No. 16 has been organized and will soon let contracts for 1 mile of sewers.

*Hastings, Neb.*—The proposition to issue bonds for a sewerage system were defeated at th evote on July 16.

*Los Angeles, Cal.*—An ordinance has been passed determing that the public interest demands the construction of certain sewers, the cost of which will be too great to be paid out of the ordinary annual income and revenue of the city. These sewers, and their estimated costs, are as follows: Outfall sewer, brick and concrete, $440,000; southern intercepting sewer, brick or pipe, $60,000; central intercepting sewer, brick and pipe, with iron river crossing, $174,000; western intercepting sewer, pipe, $80,000; several storm sewers, brick and pipe, $65,000, $275,000, $30,000, $12,000, $35 000, $9,000, $16,000, $13,000, $38,000, $27,000, $13,000 and $13,000. For particulars address F. G. TEED, City Clerk.

*Smith's Falls, Ont.*—The town has made an appropriation of $2,100 for a pipe sewer 840 ft. long. For particulars address B. E. SPARHAM, Town Clerk.

Street Work.—*Medford, Mass.*—The town has appropriated $5,000 for the continuation of Boston Ave.

*South Norwalk, Conn.*—A committee has been appointed, consisting of the mayor, T. BAKER, WM. B. RIDER, C. E., and others, to examine various kinds of pavements in use in different cities, and to report as to the kind best suited for this city, with cost of construction and maintenance.

*Buffalo, N. Y.*—Resolutions have been adopted providing for the widening of Delaware Ave. and the construction of a 60 ft. street between Bouck and Cleveland Aves.

*Cincinnati, O.*—The Board of Public Affairs will lay asphalt paving on the north end and wood block paving on the south end of Auburn Ave.

*East St. Louis, Ill.*—Bids for grading, paving and sewering Broadway have been received from Niemes & Riemann, P. W. Schneider, Stoneware Pipe Co., of Alton Ill., Jerome Winstanley, Allen & Vieths, H. Rueckling, Stifel & Ruckert, W. H. Hill & Bro. and C. R. Harrison, of Edwardsville.

*Toronto, Ont.*—Scoria block paving on concrete foundation is to be laid on Sherbourne St. CHAS. SPROATT is City Engineer.

## WATER-WORKS.

### NEW ENGLAND.

*Ellsworth, Me.*—The City Council has voted to contract with the Ellsworth Water Co., for water-works to be completed in December. Branch pond will furnish the supply. President, NATHAN CLEAVES, Portland, Me.

*South Brewer, Me.*—To be supplied with water from Bangor, Me.

*Booth Bay, Me.*—The foundation is being laid for a new tank. Pipe-laying is to begin soon.

*Franklin, N. H.*—An act has passed the Legislature authorizing the town to build works.

*Manchester, N. H.*—The city has been petitioned to build a reservoir on Wilson hill.

*West Canaan, N. H.*—A water company has been formed to supply the town with water.

*Derry, N. H.*—An act has passed the Legislature to incorporate the Derry Water Co.

*Berlin, N. H.*—An act to incorporate the Berlin Aqueduct Co. has passed the Legislature.

*Bristol, Vt.*—W. H. MUNSILL, Malone, N. Y., is to improve his water system in this place.

*Avon, Mass.*—L. E. HAWES, 75 State St., Boston, has examined and reported upon a water supply for Avon. The plan recommended is:

A collecting well 20 ft. in diameter and depth, sunk near Porter's spring, would furnish the supply. Near by would be located a 764,000-gall. compound condensing pump, which would force water partly through the distribution mains to a stand-pipe 20 ft. in diameter and 90 ft. high. The town has been authorized by the Legislature to issue bonds to the amount of $30,000. The proposed works are estimated to cost about $44,000, with distribution complete. The plan is to lay mains as far as possible with the money at hand, and extend them afterwards from the earnings of the works.

*Malden, Mass.*—Several hydrants will be placed.

*Grafton, Mass.*—A new reservoir, one mile of 6-in. mains, and a 1,000,000-gall. pump will be added.

*Gloucester, Mass.*—The town has contracted with the water company for 5 additional hydrants at $40 each. Additional mains will be laid.

*Boston, Mass.*—Proposals were received July 22 for building a water tower on Breed's hill.

*Foxboro, Mass.*—The works will probably be owned by the town. Commissioners, V. S. POND, F. WILLIAMS, and E. P. CARPENTER.

*Medford, Mass.*—Extensive improvements are contemplated. The town has voted $25,500 to purchase several tracts of land, water, and water rights. A commit-

*South Norwalk, Conn.*—The following bids have been received by W. B. Rider & Son, Engineers of the water-works extension. The contract was awarded to ADAM MILLER Saratoga, N. Y.

| Bidders. | All per cu. yd. | | | | | | | Pipe Laying per ft. | | | | | | | Sewer Pipe | | Setti'g 12-in. Gate | Dike Complete | | Grubbing per acre. | Clearing per acre. | Sand for Filter cu. yd. | Filter Basin Clearing. | Clearing Main Reservoir per acre. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Earth Excavation | Rock Excavation in Pipe Trench | Rock Excavation under Dam | Embankment in Dam | Embankment in Dikes | Cemented Rubble Masonry | Dry Masonry | Sizes 18 | 16 | 12 | 10 | 8 | 6 | 4 | 30 | 20 | | No. 1 | No. 2 | | | | | | |
| Chas Chapman, Westport, Conn | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | $550 | ..... | $550.00 |
| A. J. Hutchingson, South Norwalk, Conn | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | Lump bid | | | | but does not include cl'ar'g and grubbing | | | | | | | ..... | ..... | ..... | ..... | ..... | 38,635 00 |
| W. R. Hewel, J. Kelley & Co | .32 | $2.25 | $1.35 | .47 | .40 | $4.25 | $4.00 | $1.10 | $1.00 | .90 | .85 | .80 | .60 | .50 | $2.50 | $1.25 | .90 | ..... | ..... | $45.00 | $30.00 | ..... | ..... | ..... | 42,593.24 |
| F. Lennard, Norwalk, Conn | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | $6400,00 | $1000.00 | B'lan'e | in a lump | form | or bid | | 36,400 00 |
| Maloy, Brothers & Co., New Rochelle, N. Y | .35 | $3.00 | ..... | .48 | .45 | $3.85 | $2.50 | $1.05 | .85 | .65 | .55 | .48 | .40 | .35 | $3.00 | $1.75 | $5.00 | ..... | ..... | $25.00 | $35.00 | .85 | ..... | ..... | 43,681.16 |
| F. Thileman, Jr., New York | .30 | $3.00 | $2.00 | .40 | .30 | $3.25 | $2.50 | $1.00 in dam | .96 | .85 | .62 | .50 | .45 | .38 | .29 | $1.25 | .75 | ..... | $4784.25 | $767.40 | $100.00 | $100.00 | .50 | ..... | ..... | 42,714.40 |
| Adam Miller, Saratoga, N. Y | .23 | $3.50 | $3.50 | .35 | ... | $4.50 | $2.50 | .70 | .65 | .55 .50 | main line 45 | .35 | .28 | .25 | $2.00 | $1.20 | ..... | $4800,00 | $1300.00 | $25.00 $50.00 | North $50.00 | of .50 | Dike ..... | ..... | 34,460.70 |

*New York, N. Y.*—The following were the proposals received by the Department of Public Works for the construction of the Muscoot dam and reservoir. The contract was awarded to John McQuade, at $540,610.

| Bidders. | Grubbing, 7,000 acres. | Rock excavation, 10,000 cu. yds. | Earth excavation, 10,000 cu. yds. | Embankment, 780,000 cu. yds. | Cut stone mas'ry, 1,500 cu. yds. | Stone masonry, 45,000 cu. yds. | Brick masonry, 600 cu. yds. | Concrete, 5,000 cu. yds. | Dry Stone Wall, 6,000 cu. yds. | Lumber, 50,000 ft. B. M. | Fence wall, 80,000 lin. ft. | Sodding, 40,000 sq. yds. | Wrought iron, 20,000 lbs. | Straight pipe, 150 tons. | Special pipe, 50 tons. | 30-in. pipe, 300 lin. ft. | 24-in. pipe, 600 lin. ft. | 12-in. pipe, 600 lin. ft. | Four 30-in. stop-cocks. | Four 24-in. stop-cocks. | One 12-in. stop-cock. | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cts. | $ | cts. | cts. | $ | $ | $ | $ | $ | $ | $ | cts. | cts. | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| J. F. Dawson | 10 | 1.20 | 25 | 28 | 30 | 3.60 | 12 00 | 6.10 | 1.70 | 45 | 1.20 | 25 | 6¼ | 28 | 57.00 | 1.00 | 1.00 | .50 | 1,050 | 600 | 50 | 643,370.00 |
| J. McNamee | 40 | 2.00 | 30 | 40 | 40 | 5.60 | 11.00 | 5.50 | 3.50 | 50 | 3.50 | 20 | 8 | 28 | 60 00 | 1.00 | .80 | 50 | 500 | 300 | 60 | 1,062,300 00 |
| F. Thileman | 2 | 1.00 | 25 | 30 | 25 | 3.60 | 15.00 | 4.00 | 2.50 | 10 | .25 | 25 | 8 | 28 | 60.00 | 1.00 | 1.40 | .50 | 900 | 300 | 25 | 555,934 00 |
| Byron & Co | 30 | 1 25 | 25 | 40 | 10 | 4.00 | 13.00 | 4.00 | 3.25 | 50 | .52 | 20 | 6 | 31 | 75.00 | .50 | .35 | .25 | 1,400 | 900 | 75 | 698,897.00 |
| John McQuade | 10 | 1 75 | 25 | 33 | 23 | 3.25 | 11 00 | 5.50 | 2.00 | 30 | .70 | 20 | 6 | 40 | 70.00 | 1.00 | 1.00 | .50 | 800 | 600 | 500 | 540,610 00 |
| Bernard Mahon | 5 | 1 50 | 20 | 40 | 38 | 6.00 | 12.00 | 5 00 | 2.00 | 51 | .50 | 30 | 6 | 28 | 57 00 | 1.25 | .70 | .50 | 400 | 300 | 50 | 789,520.00 |
| Smith & Brown | 10 | 2.00 | 30 | 30 | 18 | 5.00 | 13.00 | 6.00 | 3.00 | 40 | .90 | 40 | 4 | 28 | 35.00 | .75 | .60 | .30 | 100 | 75 | 30 | 699,510.00 |
| O. H. Georsl | 1 | .65 | 29 | 37 | 23 | 4.00 | 11.00 | 4.30 | 1.90 | 60 | 1.35 | 28 | 5 | 30 | 80.00 | 1.50 | 1.00 | .30 | 300 | 150 | 90 | 714,810.00 |
| Del Genovese & Towle | 5 | 1 20 | 21½ | 37½ | 40 | 3.94½ | 12.90 | 5.99½ | 2.34 | 35 | .69 | 19½ | 6 | 40 | 75.00 | 2 75 | 2.00 | 1.00 | 500 | 500 | 300 | 692,830.00 |
| D. R. Paige | 25 | 2.50 | 45 | 20 | 20 | 4.00 | 12.00 | 6.50 | 2.00 | 50 | .75 | 30 | 5 | 50 | 60.00 | 1.00 | .90 | .75 | 500 | 250 | 100 | 509,130.00 |
| J. H. Mooney | 20 | 3.00 | 30 | 40 | 35 | 4.20 | 12.50 | 5.00 | 3.75 | 50 | 1.00 | 20 | 2 | 30 | 33.33 | 1.00 | 1.00 | .50 | 500 | 500 | 25 | 793,984.90 |

tee has been appointed to consider issuing $250,000 of bonds.

*Milford, Mass.*—A 2,000,000-gall., low pressure, compound, duplex pump and some mains will be added.

*Andover, Mass.*—GEO. A. PUTNAM, City Clerk, has sent the following:

The town has voted bonds for water-works to cost about $150,000. PERCY M. BLAKE is engineer, and Jas. P. BUTTERFIELD should be addressed for further information. Water will be taken from a large pond. A storage reservoir will be built. Population, 6,150. Construction will probably be started in August.

*Holliston, Mass.*—A franchise has been granted to W. H. BARNEY. About 4 miles of mains, a 100,000-gall. stand pipe, and a 1,000,000-gall. low pressure compound pump will be required.

*Ware, Mass.*—About 100 meters will be added this year.

*Springfield, Mass.*—J. H. HYATT, President of the Hyatt Filter Co., New York City, has made a detailed examination of the Ludlow reservoir and will soon make a proposition to the city to purify its water by his process of filtration. Meanwhile, regular improvements are going on.

*Norwood, Mass.*—A 1,000,000-gall. auxiliary Davidson pump and 1¼ miles of 6 in. cast-iron mains are being added.

*Winchendon, Mass.*—E. S. MERRILL, Chairman Board of Water-Works, has sent us the following:

An attempt is being made to get the Enabling Act of the Legislature accepted by the town. If successful, driven wells and complete works will be put in at an estimated cost of $100,000.

*Windsor Locks, Conn.*—The Windsor Locks Water Co. recently accepted the amendment to the charter which was granted at the last session of the Legislature. Pipe-laying is progressing rapidly. The foundation for the 100 by 20-ft. stand-pipe is nearly completed.

*Hartford, Conn.*—A considerable amount of cast-iron pipe is being laid, part of it to replace cement pipe.

*New Britain, Conn.*—Petitions for more and larger mains have been received by the City Council.

*Manchester, Conn.*—The new supply for South Manchester has been satisfactorily tested.

### MIDDLE.

*Lansingburg, N. Y.*—Bids will be received by the Water Commissioners until July 29, for reconstructing the embankments of the distributing reservoir.

*Medina, N. Y.*—A vote on the question of building works will be taken July 29.

*Warsaw, N. Y.*—The Warsaw Water-Works Co. has purchased land and will build a large reservoir on West hill.

*North Tonawanda, N. Y.*—The United States Water-Works Company has been incorporated at Albany, N. Y., to buy, sell, and operate water plants, franchises, rights and privileges, and to supply cities, towns and villages in the United States and Canada with water. Capital stock, $50,000. Incorporators: P SMITH, E. A. CROWN, H. M. FALES, J. H. RAND and A. HATHAWAY.

*Brooklyn, N. Y.*—Mayor CHAPIN has approved the resolutions passed by the Water Committee of the Board of Aldermen, accepting Chief Engineer VAN BUREN'S plans for increasing the city's water supply. The plans as adopted allow an expenditure of $450,000 and will include extending the aqueduct from Rockville Centre to Lake Massapequa, a distance of 10½ miles, and making such other improvements as will be necessary to add 20,000,000 galls. to the daily supply.

*Albany, N. Y.*—Only one bid for pipe and special castings being received by the Special Water Commission, July 16, no contract was awarded.

*Jersey City, N. J.*—The City Board of Finance has awarded a contract to H. R. Worthington, of New York City, for a 5,000,000-gall. pump for the high service station, at $30,500. It must be finished and delivered within five months.

*Blairstown, N. J.*—JNO. W. BLAIR informs us that he is building works to supply Blair Presbyterian Academy and the village. Tippett & Wood, Phillipsburg, N. J., are the engineers and contractors.

*Summit, N. J.*—The Commonwealth Water Co., of Newark, N. J., are building the works with CARROL PR. BASSETT, of Newark as engineer.

*Newark, N. J.*—A resolution has been adopted that the ratification of the contract with the Lehigh Valley R. R. Co. be submitted to a popular vote. Members of the Aqueduct Board and the Common Council Committee on Water Supply have since made a personal examination of, and are now discussing the Pequannock watershed scheme.

*Erie, Pa.*—CHARLES M. REED agrees to emancipate the city of its $1,100,000 debt, if the city will transfer its water works and all franchises over to him. The works have cost over $1,000,000. The revenue for 1888 was $74,000.

*Alleghany City, Pa.*—The National Water Supply Co. of Cincinnati, O., has made a proposition to furnish

*Rochester, Pa.*—A. W. MCCOY has sent the following:

Construction has not been started, as the hydrant contract has not been made with the borough. ELLIS MORRISON, New Castle, Pa., will be the engineer, contractor and superintendent. Two 1,500,000-gall. pumps will lift water from the Ohio river to a 3,000,000-gall. reservoir. There will be 6¼ miles of mains and 60 hydrants. Estimated cost, $100,000. Population, 4,800. The Rochester Water Co. will own the works.

*Wall and Wilmerding, Pa.*—Works are now contemplated for these new towns, the site of the new Westinghouse works. The reservoir will be built on the Miller farm, near Port Perry, by the Turtle Creek Valley Water Co. The dam will be 296 by 176 ft. on top and 245 by 125 ft. at bottom and 17 ft. high, and have a capacity of 4,000,000 galls. The pump house will contain an engine of 168 H. P., with a capacity of 3,000,000 galls. daily. It is also proposed to build another reservoir, as soon as needed, that will have a capacity of 5,000,000-galls.

*Mansfield and Chartiers, Pa.*—Joint meetings of the councils have been held to devise a plan for a water supply for the two boroughs. The estimated cost is $50,000. Address the Town Clerk.

pure water to the city by the gang well system. The Comptroller has since been instructed by the water committee to advertise for proposals for furnishing a supply of better water; each bidder to furnish his own plans.

*Hagerstown, Md.*—The reservoir of the Washington Co. Water Co, near Cavetown, gave way July 16, causing several thousand dollars' worth of damage. It will be repaired at once.

### SOUTH ATLANTIC AND SOUTH CENTRAL.

*Liberty, Va.*—A new reservoir is to be constructed.

*Rock Hill, S. C.*—Works are projected. Address Roddy & Whitner.

*Darlington, S. C.*—Artesian well machinery is reported to be wanted by J. C. WILLCOX.

*Covington, Ga.*—Water-works are projected.

*Albany, Ga.*—A brick reservoir recently constructed has given way.

*Savannah, Ga.*—We are indebted to J. DE BRUYNKOPS, Assistant City Surveyor, for the following:

An experimental artesian well will be sunk 2,000 ft., in hopes of securing a flow of water to the pumps, and avoiding the necessity of suction. None of the 9 wells in use give such a flow, but they are only 900 ft. deep.

*La Grange, Ga.*—An attempt to build works is being made. Address the Mayor or City Clerk.

*Sheffield, Ala.*—J. V. ALLEN, Treasurer of the Sheffield Land, Iron & Coal Co., informs us that on Aug. 6, bids will be received for a new system of water-works to cost $100,000.

*Columbia, Ala.*—W. A. BROWN, City Clerk, has sent us the following:

An artesian well has been sunk, and water rises within 12 ft. of the surface. A pumping system and reservoir are projected. Address F. F. KOERBER.

*Greenville, Miss.*—J. A. JONES has the contract to build works. He also has the contract for works at Natchez, Miss.

*Donaldsonville, La.*—Works are projected and will probably be built soon. Address the City Clerk.

*Covington, Tenn.*—It is reported that C. R. CORLASS has a 25 years' contract, and will build a pumping to stand-pipe system.

*Owensboro, Ky.*—Woodbury & Moulton, of Portland, Me., are offering $75,000 of 6 per cent. water bonds for sale.

*Newport, Ky.*—The following proposals were opened at the new Government barracks, July 15: Furnishing Stand-pipe and Tower: Northwestern Construction Co., of Chicago, $15,600; MICHAEL STOPPER, of Cincinnati, $11,148; P. Murray & Son, Cincinnati, $12,490. The contract was awarded to MICHAEL STOPPER.

The contract for furnishing and laying pipe was awarded to B. D. BARTON, of Cincinnati, at $3,300.

### NORTH CENTRAL.

*Fostoria, O.*—Coffin & Stanton, of New York, have purchased $100,000 of the water bonds at $102,000 and accrued interest. The Water Committee will at once appoint a competent engineer. Work will begin as soon as preliminaries can be arranged.

*Marion, O.*—Howland & Ellis, of Boston, Mass., contractors for the water-works, will begin work soon.

*Cincinnati, O.*—The following bids for 2 tube wells each 85 ft. deep have been received by JOHN D. CALDWELL, President of the Infirmary Department: Bradford Well & Pump Co., $963.90 each, $2.25 for each additional foot; Sattler & Conway, $650 each, $2 for each additional foot; E. A. Boluss, $750; E. A. Stinson & Co., $815; National Water Supply Co., Cincinnati, O., $2,450 for an independent plan. The contract was awarded to Sattler & Conway, Aurora, Ind.

*Wooster, O.*—Z. POTTER, Superintendent, informs us that a large amount of 6-in. pipe will probably be laid this season. The paving of the inside slopes of a 6,000,000-gall. reservoir has just been finished.

*Fort Wayne, Ind.*—Petitions are being received for extensions.

*Logansport, Ind.*—The town is considering the advisability of taking its supply from Lake Maxinkuckee.

*Broad Ripple, Ind.*—A private system of works is reported as having been completed by Kingan & Co.

*Greenfield, Ind.*—Bids for a small system of works will be received until Aug. 5. Address E. W. FELT, Clerk Water-Works Trustees. Engineer, J. H. DENNIS, 18½ North Penn St., Indianapolis, Ind.

*Huntingburgh, Ind.*—H. G. ROTHERS has sent the following:

Owing to difficulties in securing land, the Citizens' Gas & Water-Works Co. were unable to begin the construction of water-works within a year from the granting of the franchise. The franchise has been annulled by the City Council, which now proposes to put in works. The above named company is in the process of liquidation. JAS. MURRAY is City Clerk, and E. R. BRUNDICK, Mayor. Population, 3,000.

*Pinconning, Mich.*—GEO. BARIE, Secretary, informs us that a filtering plant has been proposed.

*Jackson, Mich.*—J. K. BOGERT, Secretary, informs us that the mains will be extended 3½ miles this season, and 31 hydrants added.

*St. Johns, Mich.*—Pipe-laying will begin soon.

*Albion, Mich.*—Works to cost $50,000 will be built.

*Savanna, Ill.*—F. S. GREENLEAF, Secretary, informs us that 30 3-in. tubes are being driven in the well from which the supply is drawn.

*South Ottawa, Ill.*—The Caton water-works partially supply the town, but two or three companies are now applying for a franchise. Address Mayor SHERWOOD.

*Aledo, Ill.*—S. D. E. HAYS informs us that the United States Wind Engine & Pump Co., Batavia, Ill., are putting in works for the town. The supply is from an artesian well. Cost, about $8,000. Population, 2,000.

*Bushnell, Ill.*—The city has let contracts for $25,000 water-works. Address O. C. HICKS.

*Cicero, Ill.*—The Cicero Water, Light & Power Co. has been incorporated to supply the town with water, etc. Capital stock, $50,000. Incorporators, F. S. OSBORNE, M. H. BURGETT and H. R. PEBBLES.

*Pinckneyville, Ill.*—The City Council has appointed a committee to draft an ordinance providing for the establishment of a system of water-works, and to advertise for bids for their construction.

*Jacksonville, Ill.*—The artesian well is down 1,845 ft. and progressing satisfactorily.

*Belleville, Ill.*—The Pond Engineering Co., of St. Louis, Mo., has sold the water company an aerator of sufficient capacity to purify the entire water supply.

*Janesville, Wis.*—The Janesville Water Co. is offering $100,000 of 6 per cent. bonds for sale. Address, Brewster, Cobb & Estabrook, Boston, Mass.

*Ripon, Wis.*—Works will be built. An engineer has been engaged to prepare specifications.

### NORTHWESTERN.

*Emmetsburg, Ia.*—Water-works are to be established. The supply will be from a well. Correspondence with contractors and dealers is solicited by the Mayor.

*Rock Rapids, Ia.*—Works are being built.

*Boone, Ia.*—The city has contracted for a steam pump and engine house.

*Villisca, Ia.*—The city is adding a large well to meet the increased demands for water.

*Fort Madison, Ia.*—The Fort Madison Water Supply Co. has been incorporated to supply water. The capital stock is $200,000. The trustees are DUDLEY BETTS and JAMES WATSON, of New York, CHARLES SKEHAN, W. S. COLE, J. M. DONOVAN, JOHN F. FOLEY, and EUGENE A. DIKE, of Brooklyn; HUGH M. GILLIGAN, of Plainfield, N. J., and WILLIAM WHEELER, of Bogota, N. J.

*Eldora, Ia.*—THOS. G. ALVORD, Mayor, informs us that a pumping station and 1½ miles of additional mains are needed.

*North St. Paul, Minn.*—Works are being built. Estimated cost, $27,000.

*Rochester, Minn.*—A main is to be laid to the South Minnesota fair grounds.

*Peabody, Kan.*—L. G. MORRILL informs us that 2 miles of new mains are projected.

*Galena, Kan.*—Works are being built with A. W. MCCORMICK, Parsons, Kan., as contractor.

*Springfield, Kan.*—The following is from ED. A. WATSON, Superintendent:

In May the city bought the unfinished works of the company, and has since been trying to arrange for their completion. Nothing has been done since the beginning of the year.

*Pittsburg, Kan.*—We are indebted to A. W. MCCORMICK, of Parsons, for the following:

An extension to Spring river for a new water supply and 23 miles of 12 to 4-in. mains are under consideration. Estimated cost of extensions, $200,000.

*O'Neil, Neb.*—FRANK CAMPBELL, councilman, informs us that the town will probably vote bonds for works costing about $70,000, the supply to be from wells.

*Ainsworth, Neb.*—Address W. H. BALDWIN, regarding the projected works.

*Dodge City, Neb.*—Fire protection is wanted.

*Lincoln, Neb.*—A proposition to furnish water to the city has been made by W. J. Cooper & Cole Bros., of Lincoln, Neb. A committee of three has been appointed to inquire into the report on the water resources of the city. Address the Mayor.

*Ree Heights, Dak.*—Artesian wells are wanted.

*Devil's Lake, Dak.*—The artesian well, sunk at a cost of $7,500, is proving very successful.

*Oakes, Dak.*—The council is to let contracts for sinking an artesian well, laying mains and furnishing a complete system of water supply. Address the Town Clerk.

*Redfield, Dak.*—An artesian well will be sunk by JAMES TAYLOR. Other wells are projected.

*Yankton, Dak.*—Proposals will be received until August 7 for sinking an artesian well on the hospital grounds. Address Z. RICHEY, Secretary Board of Trustees.

*Fort Keogh, Mont.*—Bids will be received until August 10 for furnishing a water supply for this post. Address Lieut. M. C. MARTIN, Asst. Q. M., U. S. A.

### SOUTHWESTERN.

*Kansas City, Mo.*—The Water Board will soon designate where 50 additional hydrants shall be set. Taintor & Holt, of New York City, are offering 6 per cent. first mortgage bonds for sale.

*Independence, Mo.*—Four miles of mains will be laid and improvements made to the pumping machinery.

*Springfield, Mo.*—A new 2,000,000-gall. pump is to be added.

*Camden, Ark.*—The company contemplates laying 2¼ miles of mains.

*Little Rock, Ark.*—FRED. J. H. RICKON, City Engineer, informs us that filters will be added and other improvements made to the water-works by the recent purchasers, the American Water-Works & Guarantee Co., Limited, Pittsburg, Pa. W. S. KUHN is General Manager.

*Gonsales, Tex.*—T. S. WALKER, Superintendent, informs us that they expect to put in water-power pumps next season.

*Cuero, Tex.*—D. H. HEATON has sent the following:

The city will issue about $30,000 of 6 per cent. water-works bonds. The assessed valuation of the town is $1,047,000. Water will be taken from Guadaloupe river. W. R. FREEMAN is in charge of surveys. Bids will probably be invited soon. Population, 2,500.

*Weatherford, Tex.*—The mains are to be extended.

*Dublin, Tex.*—A company is being formed to build works. Address S. E. GILLET.

*New Birmingham, Tex.*—T. HOWARD BARNES, Engineer New Birmingham Iron & Land Co., informs us that within 4 months a daily supply of 300,000 galls. will be needed at their furnace and rolling mill. No plans have been decided upon.

*Longmont, Col.*—GEO. W. BROWN, Superintendent, has sent the following:

I wish to express my gratitude for what you are doing for those of us who are engaged in the care and construction of water-works. The value of the volume (*The Manual of American Water-Works*) for 1888 can hardly be computed in dollars.

*Springfield, Col.*—Bids for sinking an artesian well will be received until July 27. Clerk and Recorder, P. BYRNES.

*Santa Fé, N. M.*—Extensions will probably be made soon.

### PACIFIC.

*Sumner, Wash.*—The Farmers' Water Co. has been organized to furnish water.

*Hood River, Ore.*—H. C. COE, Superintendent, informs us that they expect to lay about 2,000 ft. of mains this fall.

*Portland, Ore.*—Bids will be received on Aug. 6 for furnishing a large quantity of cast-iron pipe and a 10,000,000-gall. pumping engine.

*Hollister, Cal.*—Additional artesian wells are being sunk.

*Marysville, Cal.*—The Cape Fear West Water Co. has been organized by J. O'BRIEN, J. O'BRIEN, Jr., W. O'BRIEN, A. J. MEREDITH, and J. M. SMITH. Capital stock, $100,000.

*Modesto, Cal.*—O. MCHENRY, Secretary, has sent the following:

A stand-pipe, new wells, a 1,500,000-gall. pump for direct pressure, 1 mile of 12-in. mains, and 10 hydrants have been proposed.

*Pasadena, Cal.*—We are indebted to M. D. PAINTER, Secretary, for the following:

The North Pasadena Land & Water Co. is placing 300 meters and replacing 1¾ miles of 10-in. cement pipe with 13-in. cast iron. It has made an assessment of $5 a share on its capital stock for improvements.

*Blue Lakes, Cal.*—The Blue Lakes Water Co. intends building a dam at this place. It will be 80 ft. wide at the base, 40 ft. on top, and 30 ft. high.

*San Bernardino, Cal.*—There is a movement to enlarge the Bear Valley reservoir by building a new dam 30 ft. higher than the old one, with a view to supply water for a part of the San Jacinto plains.

*Pioche, Nev.*—A number of mining claims have been purchased for the Pioche Water Co. by C. H. PACHEN. Their plant will probably be extended.

*Salt Lake City, Utah.*—O. W. POWERS, Chairman Liberal Committee, has offered a prize of $50 for the best plan for a new water supply that may be presented by any citizen of the city before Aug. 15.

### CANADA.

*Springbank, Ont.*—An artesian well will probably be sunk.

*Toronto, Ont.*—The contract for the new pumping engine has been awarded to the Geo. F. Blake Mfg. Co., of Boston, Mass.

*Winnipeg, Man.*—City Engineer RUTTAN estimates that the Assinniboine water power scheme can be carried through for $400,000.

### Annual Reports.

NOTE.—We shall be pleased to receive from each water-works in the country its annual report, and to mention them in this column. Details of general interest will be given in *The Manual of American Water-Works*, while anything of current or particular interest will be abstracted, and presented elsewhere in our columns.

We acknowledge the receipt of reports from the following works:

*New Hampshire.*—Laconia and Lake Village; F. P. WEBSTER, Superintendent.

*Vermont.*—Montpelier; by the courtesy of JOEL HUBBARD.

*Massachusetts.*—Abington; A. H. WRIGHT, Superintendent.—Clinton; HENRY NEWHALL, Registrar.—Holbrook; E. J. CHADBOURNE, Superintendent.—Lincoln; GEO. L. CHAPIN, Superintendent.—Leominster; J. G. TENNEY, Superintendent. Contains tables of analysis.—Malden; SOLON M. ALLIS, Superintendent.—Melrose; PARKER MERRILL, Superintendent.—Mansfield; ALFRED V. ROGERSON, Treasurer and Commissioner.—Marlborough; GEO. A. STACY, Superintendent.—Natick; J. W. MORSE, Superintendent.—Northampton; J. M. CLARK, Superintendent.—North Attleborough; WALTER R. WHITTEMORE, Clerk and Superintendent.—Northborough; S. SMALL, Registrar.—Norwood; GEO. A. P. BUCKNAM, Superintendent.—Pittsfield; JNO. M. HATCH, Superintendent.—Randolph; E. J. CHADBOURNE, Superintendent.—Rockland; W. B. GROCE, Superintendent.—Turner's Falls; H. D. BARDWELL, Secretary.—Woburn; F. P. CRILLY, Superintendent.

*Connecticut.*—Wallingford, W. M. HALL, Superintendent.—Willimantic, H. S. MOULTON, Superintendent.

*New York.*—Clinton, EUGENE B. WOOD, Secretary.—Cohoes, A. T. KNIFFIN, Superintendent.—Geneseo, THEO. F. OLMSTEAD, Treasurer.—Johnstown, J. J. BUCHANAN, Superintendent.—Ogdensburg, A. H. LORD, Superintendent.—Schenectady, M. O. CALDWELL, Superintendent.

*Pennsylvania.*—Bradford, C. J. LANE, Superintendent.

*Delaware.*—Dover, T. F. COOKE, Chief Engineer.

*Tennessee.*—Nashville, GEO. RYER, Superintendent.

*Ohio.*—Clyde, O. W. HARRISON, Secretary.—Dayton, CHAS. A. HERLIG, Secretary.

*Michigan.*—East Saginaw, H. M. NEWTON, Secretary.—Port Huron, LEWIS ATKINS, Secretary.

*Wisconsin.*—Madison, W. W. DANIELLS, Superintendent.

*Minnesota.*—St. Paul, JOHN B. OVERTON, Superintendent.

*New Brunswick.*—Fredericton, ALEX. BURCHILL, Superintendent.

*Nova Scotia.*—Bridgeton, JOHN L. COX, Superintendent.—Halifax, E. H. KEATING, City Engineer.—Truro, A. L. ARCHIBALD, Engineer.

*Prince Edward's Island.*—Charlottetown, DUNCAN MCLEAN, Secretary.

*Ontario.*—Sarnia, ROBERT TURNER, Superintendent.—Stratford, JOHN CORRIE, President, Stratford Water Supply Co.—Woodstock, G. C. EDEN, Clerk.

*British Columbia.*—Victoria, PETER SUMMERFIELD.